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Association of Iron and Steel Electrical Engineers

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The Protective Tariff Was Never Needed More Than It Is Now

On May 31, 1932, the American Iron and Steel Institute filed a complaint on the dumping into this country from foreign countries of angles, bars, including concrete reinforcement bars, beams, billets, blooms, channels, joists, plates, rods, sheets, structural shapes, wire nails and wire netting, in violation of the Antidumping Act of 1921. This complaint was filed with the Bureau of Customs of the Treasury Department, and was immediately made the subject of investigation by the Bureau.

Goods are dumped, within the meaning of the law, when they are sold for export to the United States at less than the prices they are sold for home consumption in the country of origin; or, when they are sold for export to the United States at lower prices than sold to other countries; or when sold to the United States at less than their cost of production.

The American Iron and Steel Institute's complaint necessitated investigation by the Treasury Department abroad to determine the prices at which the goods were sold for home consumption, and also to determine if they were sold for less than the cost of production.

The net results up to the present time are that final appraisements are being suspended on all invoices of imported steel products, although the goods are being delivered to the importers. The importers, however, do not know what duty they will ultimately have to pay because the entries remain open until it has been finally determined whether or not dumping exists. In respect to four products, namely, bands, bars and channels from the Saar Basin and wire netting from Germany, not only are the appraisements withheld but on each importation the importer is obliged to give a bond to the Government in the full amount of the value of the goods.

Our antidumping statute is cumbersome and slow, and difficult in operation, and it takes a long time to put into effect the penalties that are imposed by it. It is, however, well known that the importers are seriously apprehensive of the ultimate result and that in the meantime they are considerably hampered in their importations.

You need not be reminded that at the present time the steel industry of the United States is in an extremely depressed condition. The main cause of the condition of the steel industry is found, of course, in the general business situation, but it has been terribly aggravated for the last year and a half by the dumping into the United States of foreign steel products at prices so hopelessly low as to make competition impossible.

Contrary to the popular conception, the United States tariff duties on steel products are extremely low as compared with the rates of duty generally. For example, the rate on beams, girders, and other structural shapes is only one-fifth of one cent per pound, and the rate on steel rails is only one-tenth of one cent per pound. Yet to read the fulminations of free traders, tariff reformers, and economists of the colleges, the steel industry enjoys the benefit of a Chinese tariff wall.

At no time has our tariff act kept out foreign steel products whenever conditions would permit their entrance, but because of the extremely low prices the foreigners are now making, the tariff is no protection at all. This is particularly true in the case of imports from countries which have abandoned the gold standard. This action of those countries, among them being England and Sweden which are steel producing countries, has been disastrous to the United States in two ways. The depressed value of their currencies has enabled them to ship into this country their products at values less than half what they were when the Tariff Act was enacted, and on the other hand, the increase in the value of the dollar as compared with those currencies has made it impossible for them to buy American goods. In other words, our imports from other countries have relatively increased, and our exports have greatly decreased, and in some instances have been discontinued entirely.

The dumping of foreign steel is a serious menace now, for it is a direct cause of a vast amount of unemployment. This is self evident when it is considered that this country has the capacity and the means to produce all the steel that can be consumed here. It follows, of course, that every pound of steel that is imported displaces that much American-made steel, and is the immediate cause of a proportionate part of unemployment.

Therefore, the present effort of the domestic steel industry to stop the practice of dumping of foreign steel is directly in the interest of, and will inure to the immediate benefit of the workingmen of the steel industry. There has been already submitted to the Government considerable evidence to support the charge of dumping, and the Government itself is conducting investigations abroad, but because of the rather cumbersome provisions of the Antidumping Act of 1921 progress is necessarily slow. Unlike other countries where the administrative officers have substantial authority and power to correct evils that develop in customs administration, or in the importation of goods, our officials are restricted and hampered by statutory provisions.

While it is true that the importations of steel during the year 1932 do not show an actual increase over prior years, they have not shrunk nearly as much in proportion as has the domestic industry. The protective tariff was never needed more than it is now.

The President of the Association of Iron and Steel Electrical Engineers invites every member to write to his respective United States Senator and Member of the House of Representatives at Washington, suggesting that they support legislation that will enable our Iron and Steel Industry to successfully compete with foreign Iron and Steel Producers.

ADVERTISING PAGES OMITTED

Precision Measurements of Mechanical Dimensions By The Use of Electricity

By S. B. TERRY
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▲

Presented before the Pittsburgh District Section of the A. I. & S. E. E., January, 1933.

Measurements are required in all the things we do or make. The sugar we put in our coffee is measured by spoon or by guess. Very many measurements are made by guess and it is the problem of taking the guess out of measurements that leads us to better methods of measuring. All measurements are comparative, whether they are made directly or by an instrument which is set to a physical representation of the desired dimension. Interchangeable production depends on the ability to make accurate measurements. The medium by which these comparative dimensions are made, I will more often refer to as a gage.

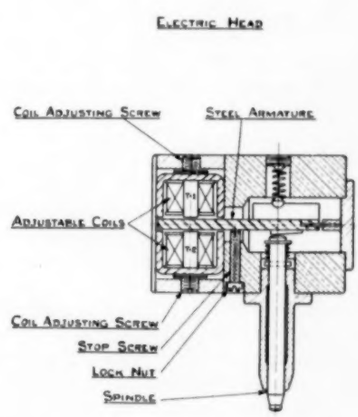
Gages are too often classified as a necessary evil, but who would attempt to turn out accurate parts or material without some means of comparing its quality. Only as improved and more accurate methods of measuring are introduced, is it possible to improve and produce more accurate parts. The demand is continually for greater accuracy in our product. This accuracy may mean greater life in the satisfactory operation of some mechanism or it may mean a saving in raw material. This demand for accuracy makes it necessary to construct gages which are not entirely dependent on an operator. It is necessary to minimize the human factor in gaging, to remove the so-called "feel" and not depend entirely on the skill of the operator.

In the production of machine parts and the material that goes into the machine, mechanical apparatus has played the greater part in establishing dimensions. At one time, a piece of string, or a stick, may have answered the purpose, or the width of the hand. The stick was next marked with lines and there was a scale. The micrometer screw made it possible to meet the demand for finer measurements. With a micrometer it is possible to measure in thousandths and ten thousandths of an inch. By improved instruments, even hundred thousandths of an inch are easily measured. However, such a measuring machine has its limitations. It is bulky and the part to be measured must be brought to the machine. It is not a production machine but is very desirable in the establishment of precise linear dimensions.

For determining accurate measurements by purely mechanical means, there must be a multiplying lever. It may be the micrometer screw, a rack and pinion as used in indicators, or various modifications of the mechanical lever. These all have certain limitations. They are delicate if sensitive, subject to vibration which slows up their operation and subject to wear which affects their accuracy. The scale by which the movement of these levers is determined, must necessarily be adjacent to the gaging contact.

In order to obtain more satisfactory ways of making mechanical measurements, electricity has been substituted for this mechanical lever. Several types of electric gages have been developed. Some are magnetic, others operate on high frequency capacity using a radio circuit for amplification, and there are other methods with which I am not sufficiently acquainted to attempt a discussion. One of the great advantages of using an electrical system is the fact that the indicating instrument, which the operator must observe to obtain an indication of dimension, can be placed in any convenient location, providing the particular system used is not subject to vibration.

FIG. 1



The particular method I wish to discuss with you is a combination of mechanical and electrical gaging. The contact with the part which is being measured is a mechanical contact, and any movement of this contact point is magnified by the electric circuit. This electric gage is a comparator, adaptable for external, internal, or continuous measurements of extreme accuracy and is set to the required limits by means of maximum and minimum master standards. This gage, as mentioned before, combines a mechanical contact and an electric circuit in such a manner that size variations in the parts or material being gaged are shown in a greatly magnified and visible form on an indicating instrument.

The electric details of this gage consist of three parts, namely, the electric head, the power unit, and the indicating unit (micro-ammeter). The gage operates on 110-115 volt, 60 cycle alternating current. The power is usually obtained from a standard lighting circuit, providing the voltage and frequency remain reasonably constant. When the required cur-

THE PROTECTIVE TARIFF WAS NEVER NEEDED MORE THAN IT IS NOW

rent is not available, a motor generator set may be used to supply the necessary power.

In the electric head, Fig. 1, is shown a steel armature mounted on a flat spring pivot and positioned between two balanced coils T_1 and T_2. These coils are adjustable. The position of the armature betwen these two coils is governed by the mechanical contact the spindle makes with the part which is being measured. This contact may be directly or indirectly made with the part depending on the mechanical arrangement of the gage.

The power unit, as shown in Fig. 2, contains a voltage regulator which is an over excited transformer and acts as a shock absorber to iron out the effect of small voltage variations in the power supply. There is a 10 to 1 transformer, a pair of balanced coils and a rectifier which supplies a direct

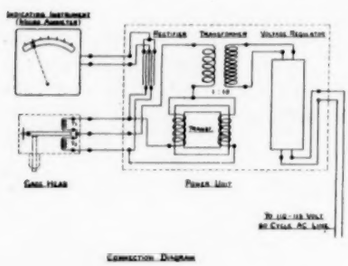


FIG. 2

current to the micro-ammeter. The two balanced coils are connected to the two balanced coils in the gage head by a bridge circuit, similar to a Wheatstone bridge, and the circuit is balanced by adjusting the coils in the gage head. Any slight movement of the armature in the gage head produces a large unbalanced condition in the bridge circuit. This is indicated by the micro-ammeter. Magnifications of 500 to 50,000 may be obtained with this electric gage. The magnification is governed by the amount of air gap between the adjustable coils and the armature in the gage head. By reducing the air gap, the magnification is increased and by increasing the air gap, the magnification is reduced.

The application of this gage to the continuous measurement of strip steel is particularly interesting. Such gages have been operating successfully for nearly a year.

In the continuous measurement of cold strip, hardened precision rolls contact directly with the strip, one on the upper and the other on the under side. These rolls are held in contact by spring pressure and are forced together, or apart, by variations in the thickness of the strip passing between them. The variations in the distance between the gaging rolls are magnified by the electrical circuit and are indicated on the micro-ammeter. This indicating instrument (micro-ammeter) may be located in any convenient place in the mill or at a central station. It is wholly unaffected by vibration. The gaging rolls are usually mounted so that they will contact not over three inches in from the edge of the strip.

Figure 3 shows a continuous gage for the measurement of cold strip steel. The upper roll is in a relatively fixed mounting while the lower roll is in a hinged mounting with an adjustable spring pressure which tends to keep it in contact with the upper roll. The maximum opening between the gaging rolls is about ¾". This allows the irregularities in edge of the strip to pass through the gage without damaging the gage head. The head is on a flexible mounting with spring balance, or with a counter balance, so that it will follow the path of the strip as it is wound on the reel. The path of the strip varies as it is wound on the reel. It is necessary to keep the center line of these two rolls at right angles to the strip so that errors in measurement will not be introduced by any angular variation in contact. This is accomplished by mounting the flexible head on arms whose spacing is varied to produce an equivalent long radius of travel with a short mounting.

The flexible head is mounted on a rail with screw adjustment to facilitate the lateral positioning of the gage to accommodate various widths of strip. A lever may be used to quickly move the gage on to the strip in gaging position after the strip has been threaded through the mill and tension has been applied. The rail may be mounted on the apron of the mill or on a separate pedestal, when it is found desirable to locate the gage adjacent to the winding reel. Two gaging heads can be used when it is found desirable to measure each edge of the strip. Built into the flexible head is a micrometer screw which reads directly in ten thousandths of an inch. With this the gaging rolls are adjusted for the thickness of strip it is desired to produce. The indicating instrument is adjusted for zero reading at mid-scale

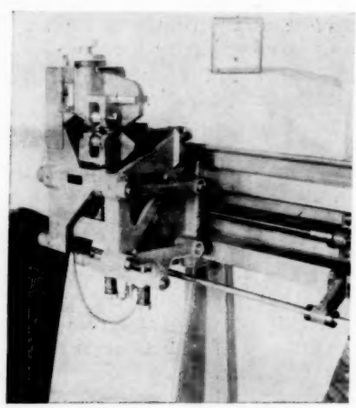


FIG. 3

and any variation plus or minus from the desired thickness of strip is shown on the indicating instrument. The scale of this instrument is graduated so that 1½" on the scale is equivalent to .001" with graduations for each .0001". The scale is graduated plus or minus .001" and can easily be read at a distance of ten or fifteen feet. This magnification may be easily reduced by adjusting the coils in the electric head so that the instrument will read plus or minus .002", or plus or minus .004", if desired.

A Photo Electric Recorder may be used in combination with the electric gage to obtain a permanent record of the accuracy of the strip over a certain period of time or during a particular run. Variations in the thickness of strip are recorded on ruled paper, the graduations of which correspond to those on the indicating instrument. The recorder operates on 110-115 volt, 60 cycle, alternating current. This instrument may be mounted on the control panel or placed in the superintendent's office.

With the electric gage it is possible to automatic-

ally make corrections for the variations in thickness of strip, which are detected by the continuous gage. Mercury contactors are used in the indicating instrument to close the circuit and through a series of relays and two selsyn motors, one of which is directly connected to the working roll shaft, operate the screw-down when the required limits have been reached or exceeded. There is a time delay in the circuit to allow for speed of travel of strip. The screw down will be operated in steps adjusted to suit rolling conditions and the delay allows time for the corrected strip to reach the gage. It is necessary to provide a circuit breaker so that when the gage is removed from the strip, the automatic control will not run the working rolls to the top of the mill.

When mills are operated at 125 feet per minute rolling speed, it is possible to use the ordinary hand micrometer to measure thickness of strip. When this speed is stepped up to 350 or 400 feet per minute some other method of measuring becomes a necessity. The continuous gage operates satisfactorily over any range of speeds at which it is possible to operate a cold strip mill.

The electric gage has been applied in the measurement of machine parts where extreme accuracy is required. The electric circuit was first developed by the General Electric Co. of Schenectady, N. Y. for use in the gaging of refrigerator parts. It is particularly adaptable for use with gaging fixtures which make several measurements at one time. The indicating instruments can be grouped in such a manner that an operator can read several instruments at a single glance. The gage is being used in the automotive industry, in the selection of wrist pins and in measuring the bore in connecting rods. It is also used to measure cylinder bores. It can be readily applied in the construction of automatic gaging machines for the inspection and selection of parts to very close tolerances.

The adoption of this gage has paved the way for greater refinements in machining operations and has greatly reduced the cost of inspection.

DISCUSSION

Discussion Presented by

J. A. Burg, Mechanical Engineer, Electrical Dept., Carnegie Steel Company, Munhall, Pa.

S. B. Terry, Asst. Mgr., Gage Division, Pratt & Whitney Co., Hartford, Conn.

C. O. Franklin, Asst. to Electrical Supt., Carnegie Steel Co., Munhall, Pa.

J. Farrington, Electrical Supt., Wheeling Steel Corp., Steubenville, Ohio.

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R. E. Murphy, Engineer, Esterline Angus Company, Pittsburgh, Pa.

A. L. Milton, Engineering Dept., Wheeling Steel Corp., Wheeling, W. Va.

W. A. Simpson, Power Engineer, Timken Roller Bearing Co., Canton, Ohio.

W. Anderson, Engineer, General Electric Company, Pittsburgh, Pa.

J. A. Burg: As regards the error in ball bearings, could not this be disregarded since the pressure is always in one direction?

S. B. Terry: When you roll at approximately 300′ per minute gage rolls are operating 600 revolutions per minute. If they are not concentric your indicator will show a difference between the high and low. This indicator lever operates full scale within a fraction of a second. When we talk about automatic devices, 100 a minute, we have to go to a speedier method. For .01 of a second we are using the thyratron tube for control.

C. O. Franklin: Have you ever used a graphic instrument in connection with this device, so that you could obtain a continuous record of the variations in thickness of the strip?

S. B. Terry: I have in my office, records made on a photo electric recorder that you can run in parallel along with indicating instruments. The operator can have an indicating instrument at his machine and a recorder on the control board or in the office, which will show a record of a particular run or for a certain period of time. It will give you a permanent record on ruled paper.

C. O. Franklin: Do you use a photo-electric type of recorder because it has greater sensitivity than the ordinary graphic instrument?

S. B. Terry: We are using it because it works into this circuit. It is operated along the same idea as the micro-ammeter, only in place of this pointer you have a little mirror on your rotor which throws the light onto photo electric cells. The reason for photo-electric tubes is this: if you consider putting a pen on this micro-ammeter, which is very sensitive, there is not strength enough to draw the pen across the paper—the photo-electric tubes supply the necessary power to operate the pen on the ruled paper. There are other recording instruments on the market; some are used to measure the amount of coal passing over a belt. That would not do when talking about .0001 of an inch. The photo-electric recording device is the most accurate I know. You can step that up to measure .000001 of an inch.

J. Farrington: Have you made any installations of your automatic screwdown?

S. B. Terry: As yet there has not been an automatic screw-down control put in operation. We have quoted on such a device, but as yet we have not put one in.

W. Dudley: In gauging the thickness of strip, how is the mechanical connection made between the rolls which contact the strip and the indicator head? How do you avoid lost motion in the connections?

S. B. Terry: We have a spindle which is held to a close fit in a long sleeve. This is a hardened and ground spindle in hardened, ground and lapped bushings and the travel is in the "up" direction. With this gage head we have increased the magni-

fication to read .000003 of an inch per graduation on our scale, and we do not detect any error due to this sliding mechanism.

W. Dudley: Where would the gauging rolls be located that measured the thickness of the strip?

S. B. Terry: We have here a gage head with an upper roll on a fixed mounting and a lower roll on a hinged mounting. The location of the electric head which is used to measure the variation in distance between the rolls depends on the tolerance for the product. The electric head is built for a high magnification and when the magnification is reduced the divisions on the scale are not uniform consequently when we are measuring in thousandths of an inch as for strip steel we use a 2:1 reduction as shown. As an explanation of this variation in division you might consider the alternating current curve. The instrument is set to read on the flat side of the curve. As the magnification is reduced the radii of this curve enter into the spacing of the graduations, and we do not get a uniformly progressive scale; consequently when plotting for wider tolerance, we make a reduction in our gage mounting. In other words, we are keeping our gage on the higher magnification and in effect reducing the tolerance.

W. Dudley: Consider a rolling speed of 400 feet a minute on 20 gage strip which did not happen to be uniform in thickness, what variation from actual gauge will be indicated due to the inertia of the moving parts in the gage head.

S. B. Terry: We will measure whatever you can produce on the mill. If your mill is capable of maintaining .0005 of an inch, we can measure .0005 of an inch and allow 3 inches of scale to do it.

W. Dudley: On strip traveling at 400 feet a minute, your mechanism could not follow the variations if they were too closely spaced along the length of the strip, could it?

S. B. Terry: If you were getting "hills" and "valleys", we will say, running at high speed, the instrument would read your average, if you had such a condition running at 400 feet a minute with the "hills" one foot apart, the gage would read the average thickness.

R. E. Murphy: There are two things which seem to me might enter into the application of this device. If the inequalities in the steel are far enough apart to cause a bouncing of the gauge rolls and you have but four pounds pressure, would not the bouncing interfere with the accurate reading of the meter? Would there not be difficulty in starting the strip through the gauge head? How would continuous strip be handled where the steel is welded at the junction of individual sheets?

S. B. Terry: Where you have strip winding on a reel, it is better practice to get tension on the strip before you slip the gage on. The gage is adjustable sidewise to take care of varying widths of strip. Also, remove gage from strip before you drop your tension. Get your gage on and off while strip is running. This prevents skidding which will happen if your strip is still. The first gage installed has 4½" overhang. I see no necessity of going any farther in from the edge than 2". It depends on the mill. A certain strip I have watched for a considerable period of time shows a reduction for ¾" from edge. We checked that very carefully. It was 30" wide and I found a variation of not over .0002" for this width except for the ¾" at each edge. There were hundreds of feet of strip which did not vary more than .0002" longitudinally.

A. L. Milton: Slight irregularities in the strip and the magnification of same gives you a little series of "hills" and "valleys" on your indicator, which I believe would have to be averaged by means of some electrical device to operate the screw-down and not depend on the contact of the spring of your indicator in either direction operating screw-down.

S. B. Terry: There would be in the circuit of that relay system, a certain time element whereby your gage would remain in contact some time before it would operate. We would not want it to hit one high spot and start to operate the screw-down. In other words, there would be a time control so that the gage must stay in contact for a certain period of time before anything happens. That can be adjusted to operating conditions.

J. Farrington: We measured the thickness of a strip coming from hot strip mill by laying it out on the floor and gauging it with a micrometer every four feet and then took it to the cold mill and checked these readings with a micrometer. We then put the electric gage on the strip and tried to check the electric gage with the same points on the strip where it was marked by the two different mills and then plotted the curve. The electric gage was more constant than either the micrometer readings and showed very plainly that men cannot be relied upon, as the two readings taken in the hot strip and new process mill showed quite a variation. The electric gage ironed out those variations and gave us a truer reading of the gauge of the strip than the men could do with micrometers. We found we could not get the electric gauge on the strip when not in tension, without hurting it. You can not put the gauge on the strip unless you have it in tension; therefore you lose approximately twenty feet of your strip before you get it on. We have followed the gauge of the strip to within one-half a thousandth of an inch at a speed of two hundred and sixty feet per minute.

J. A. Burg: If it is necessary to set the gage in the beginning by means of a micrometer, does not the human element enter in? If the man who sets the gage is out slightly in his setting, the entire indication would be out by the amount of his error.

S. B. Terry: We still have to depend on the man to set up his instrument at the correct reading. We have not yet been able to devise any way to make that automatic; or follow from .080" down to .009" without someone adjusting it. On your first pass from hot strip you will get more variation of up and down; that gradually begins to disappear on successive passes.

J. Farrington: The ends of a strip are always heavier than the middle, and we try to save those ends; because they represent a percentage of your strip and affect the yield of same. We have kept the gage on the strip until it snaps out of the roll. Many conditions arise that would throw the gage out of your housings, so we do not put it on until the strip is under tension.

A. L. Milton: Relative to variation after the first pass, as compared to the finishing pass, the irregu-

(Please turn to page 63)

SYMPOSIUM

ON

Spoilage of Material Due To Grease and Oil Dripping from Electric Overhead Traveling Cranes and Runways

PRESENTED BEFORE THE

Lubrication Engineering Division

OF THE

Association of Iron and Steel Electrical Engineers

WILLIAM PENN HOTEL, PITTSBURGH, PA. NOVEMBER 12, 1932

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Spoilage of Material Due To Grease and Oil Dripping From Electric Overhead Traveling Cranes and Runways

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PAPERS PRESENTED

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By C. J. DUBY
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This subject is very important in the Steel Industry, and particularly, in departments where the finished product, such as tin plate, sheet, or strip steel, is being processed. In almost all cases, these products, after being hot rolled on the mill, must be sheared, pickled, annealed, and cold rolled, and for tin plate, a second annealing and pickling, known as white annealing and white pickling, after which the plate is taken to the Tin House for tinning.

Electric overhead traveling cranes are used for handling the material through these various stages of processing, and it is very important that there should be no oil nor grease dripping from the crane or crane runway, which might drop on the material being handled or on the floor where the material may be placed. If oil or grease is used too freely in the journal boxes of the bridge and trolley track wheels, it will drip onto the girders, and in a short time will cause the girders to become slippery, which is a very dangerous condition for the repairmen when working on the cranes or the crane runways, and certainly is against all good safety practice. Furthermore, in time this excess oil or grease will drip from the girders.

In the Sheet and Tin Department, after oil or grease is dropped on top of a pile of sheets or black plate going to the squaring shears, it is evident that the oil or grease spot will contact with another sheet or black plate when re-piling after shearing, and thus spoil two sheets. The packs of sheet or black plate are then opened and the oil or grease spots come in contact with other sheets. The sheets are then pickled in a sulphuric acid solution, which will not dissolve the oil or grease, but, due to the agitation of the pickler, the surplus will be washed off, leaving a spot on the sheets. The surplus grease that is washed off will separate into small particles in the solution, and eventually, will be picked up by other sheets, and, of course, will increase the spoilage.

The sheets are then piled in preparation for annealing, and, of course, this brings the sheets with oil or grease spots in contact with clean sheets. The sheets are then charged into an annealing furnace and the heat of the furnace burns these particles of grease, which produce carbon deposits on the sheets. These carbon deposits cannot be removed without considerable expense, and if the defective sheets are allowed to be cold rolled, the carbon deposits become more difficult to remove. One of the most critical cases with which we have to contend, is that of deoxidizing black sheets. If a few sheets with grease spots are allowed to be in the charge, they are likely to affect the entire charge and produce what is known as "smoked" plate. This would then require opening the entire charge and re-deoxidizing.

In the manufacture of tin plate, these spots are evident throughout the subsequent processing to the Tin House. The flux in the tin pots has very little, if any, more effect on the oil or grease spots than the acid in the picklers, and the result is that, after tinning the plate, the spots are still in evidence and the tin plate is rejected as a prime and becomes seconds or wasters. This is also true of black plate, sheet iron, or strip steel, which are to be lacquer coated, color coated, enameled, or galvanized.

From the foregoing, it can be readily understood how a grease spot on one sheet can be carried on through the various stages of processing so as to affect a number of sheets. This, of course, is very costly to the manufacturer, and every precaution should be taken to prevent oil or grease dripping from cranes.

The crane manufacturers have given considerable study to this problem so as to build cranes of a design that will prevent the dropping of grease and oil. The use of roller bearings on cranes of late design has almost entirely eliminated this trouble. Furthermore, I believe that controlled lubricating systems will lend themselves in a helpful manner in this instance. However, we still have the older type cranes in our plant, and therefore, had to find ways and means to prevent the oil and grease from dripping.

Most of the oil or grease dripping from cranes comes from the bridge and trolley track wheels, which are lubricated in two ways; one, by using wool waste soaked with oil packed in the journal boxes, and the other, by the use of a grease recently developed for journal boxes. Using wool waste and oil, or what is commonly called "dope", in the journal boxes, a great deal of care must be exercised in packing the boxes so as not to put in too much; otherwise, it will cause the oil to run out the sides and drip. However, the waste must be kept loose or it will not expand and rest against the shaft.

A crane, to run properly, must be well lubricated.

THE PROTECTIVE TARIFF WAS NEVER NEEDED MORE THAN IT IS NOW

This, however, does not mean that all of the oil cups and grease connections should be overloaded and have a smeary appearance. A sufficient amount of lubricant, properly placed and at regular periods, will give much better results. I also believe that the cranemen should not be depended upon to grease and oil the cranes. This job should be handled by someone in the electrical gang who has been trained for this particular work, and he in turn should be held responsible.

A simple method for greasing cranes, which has given excellent results, is to have two containers located in a convenient place. In one of the containers, there should be enough wool waste soaked in black oil to pack the track wheel journals in all the cranes. The other container is to be used as a receptacle for receiving all of the old "dope" taken from the cranes. Once a week, preferably on Sunday when most of the cranes are idle, the men that have been assigned to grease cranes, remove all of the old "dope" from the journal boxes and re-pack with new wool waste soaked in black oil. The container with the old "dope" is then handed over to someone to loosen up the waste and replenish with fresh oil. After the cranes have been greased, and particularly, for the first couple of turns, the cranemen are cautioned to watch for and wipe off drippage.

We have been using ordinary black oil for this purpose and have obtained satisfactory results. We have tried some special grease in the journal boxes, which was held against the shaft with a small plate on springs, but we have had considerable trouble using this grease, in not being able to lubricate the flange of the brass satisfactorily, although we had grooves cut in the flange to allow the grease to work through. From our experiences, we would much prefer the use of wool waste and oil in the journal boxes on the old type cranes.

In conclusion, I might add that electric overhead traveling cranes can be kept well lubricated and free from a smeary appearance by exercising a little care in the method of application.

By R. J. HARRY
Engineer, Alliance Machine Co., Alliance, Ohio.

I have been asked to present a few remarks on the subject of grease and oil dripping from cranes and since I represent one of the manufacturers of mill type cranes, it was suggested that I should discuss the subject from the standpoint of design.

During the past few years many improvements have been made in the design of cranes, especially with regard to the enclosing of gears and having said gears operate in a bath of oil, and these improvements have more than justified the extra expense by the low cost of maintenance and reliability of operation.

Several good designs of crane trolleys have been developed, some employing spur gears in enclosed gear boxes, while some employ worm gears with enclosed cases.

In the past few years the development in the design and efficiency of worm gears has been very pronounced and it is possible to secure relatively large reductions and still obtain an efficiency of greater than 95 per cent. Since it is absolutely necessary to equip the worm with anti-friction thrust bearings and to operate the worm in a bath of oil and keep foreign particles from getting inside the gear housing, it is obvious that a good worm drive installation is essentially a drip-proof job. In most cases it is possible to install the necessary speed reduction in one worm unit and consequently with worm drive there is less possibility for oil leakage. During the past few years improved types of oil seals have been developed to prevent the escape of

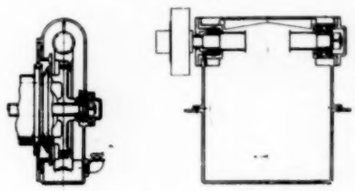

FIG. 1

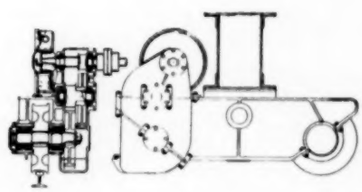

FIG. 2

oil between the periphery of the drum and the worm gear case and as a consequence this type of drive for hoist motion is ideally adapted for drip-proof construction. The worm drive has the added advantage of being practically noiseless.

Since, from a safety standpoint, it is desirable to have the brake on a hoist as close as possible to the drum to prevent the dropping of a load, in case of mechanical failure, the worm drive is the safest hoisting device possible as a brake of relatively small torque capacity can be mounted directly on the worm extension, this brake having the torque rating of the motor used. In order to obtain the same safety with spur gearing as you have with worm drive, where the worm gear is mounted on the drum, it would be necessary to install a brake on the drum pinion shaft. Since there are usually three sets of gear reductions on a hoist, the torque on the drum pinion shaft is so great that the size of the brake would become prohibitive.

Figure 1 shows a typical worm driven hoist with the worm gear mounted on the drum and the brake wheel mounted on the worm shaft. Note the rawhide seal on the worm shaft bearing, and the ample oil reservoir.

Owing to the fact that anti-friction bearings are sealed to exclude dirt and to retain the lubricant, and since the lubricant usually recommended is grease, this type of bearing installation is used almost exclusively where drip-proof design is required.

Our company has recently spent much time and effort in developing a bridge drive which would incorporate all of the desirable features and Figure 2 shows this drive applied to a compensating truck. Since it is the primary purpose of this paper to discuss the anti-dripping features of this design we will proceed to that point first and then discuss the other advantages which accrue because of the uniqueness of this design.

You will note that the gear case is an integral part of the truck, and can be of steel casting or

welded steel construction. The portion of the gear case included by letters A, B, C, D, is cast integral with the truck and the joints A, B, and C, D, are machined with the truck. This prevents any misalignment and saves the time of fitting in the field and its attendant ills, and reduces to an absolute minimum the number of joints which are the potential source of oil drippage. When the bottom of the gear case, which is the oil reservoir, is bolted

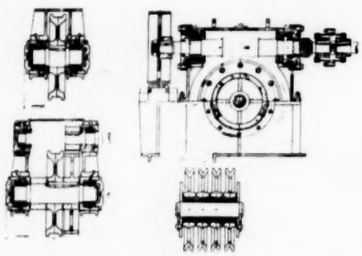

FIG. 3

to the center portion at CD and the upper portion at AB, we obtain an oil sealed drip-proof job. When the crane is at rest the oil in the lower gear case is at the level of the oil plug and this level is such that no joint is subjected to oil pressure or leakage. One of the most frequent causes of oil drippage is that bearings and gears are oiled too frequently or the amounts of lubricant administered are too great. You will note that the only place where lubricant can be applied is through the overflow plug which prevents the oil level from being raised to a point higher than the engineer intended.

This design lends itself particularly well to antifriction bearings as safe, clean and abundant lubrication is always assured and since these desirable features are necessary for the prevention of wear in the bearing accurate gear centers are maintained, thereby producing a quiet, smooth running crane, and since the gears are meshing on the pitch line the minimum of wear is obtained and long life guaranteed.

In developing this drip-proof end truck, safety was always kept in the foreground, and accounts for the substantial construction of the gear cases. Even should the track wheel shaft become fatigued and break, the gear could not fall to the ground. In recent years crane specifications have called for the track wheel gear to be located adjacent to the track wheel and between the bearings. In order to equalize the load on each bearing with the inside gear construction the track wheel shaft has to be made excessively long and it is usual to install a distance piece between the track wheel and the bearing equal to the hub length of the gear. This excess length results in increased cross section of the track wheel shaft in order to prevent excessive deflection, and requires more end room on the crane runway. This is shown clearly by Figure 3.

Many attempts have been made to provide drip-proof lubrication for track wheel gears located between the bearings but owing to the inaccessibility of the gear and pinion and the additional space required for installation it has never been successful. The end truck shown in Figure 2 combines all of the desirable features and provides drip-proof lubrication and at the same time gives the maximum of safety and accessibility.

Since the necessary gear reduction can be installed on the end truck, to give the required bridge speed it is unnecessary to use a back axle motor on the bridge. Since most of the oil leakage on bridges originates in the back axle bearing and the motor gear case, the elimination of these parts helps materially to control oil drippage. Where sleeve bearings are used on motor jack shafts every time the motor is reversed the oil film is squeezed out, and as these bearings wear the oil leakage becomes more pronounced. The elimination of the motor jack shaft also results in mechanical advantages, as without the jack shaft gear it is possible to locate the motor closer to the girder, resulting in a narrower footwalk and less torsional stresses on the girder. The maximum torsion which can be imposed on the girder by the motor is equal to the maximum torque which the motor can develop, whereas this torque is approximately four times as great when axle bearings are used, and the standard gear reduction employed. Since the torque developed in the line shaft with a motor having no jack shaft is only a small fraction of the torque developed when the motor has a jack shaft it naturally follows that much smaller line shafts can be used and still have the same safety factor as with the larger diameter shaft and motor jack shaft.

With the end truck construction shown on Figure 2 the torque reactions are taken by the end truck. These end trucks are sufficiently heavy that practically no extra material need be added to meet the stress requirements and this location for all of the bridge gearing is consequently the most logical location.

If extremely quiet operation is required we recommend the use of helical gears. The slight thrust that would obtain by the use of the single helical gear being taken care of by bearings having the necessary thrust characteristics.

We also recommend the use of flexible couplings on the line shaft adjacent to the gear box to compensate for any misalignment on account of the articulation of the trucks, or deflection or twisting of the girder.

Another reason for enclosing the gears in absolutely oil tight cases is not only to keep the oil in but also to keep out harmful grit. The use of rawhide seals in all bearings where oil leakage could occur produces oil tight construction. Since most cranes are equipped with sanders it becomes imperative to keep the particles of sand out of the bearings and prevent the sand from getting on the gear teeth in order to secure the minimum of wear. This is accomplished in our end truck without complicating the design. Furthermore, since no oil or grease can get on the track the need for frequent sanding becomes unnecessary.

You will note that we have shown the hydraulic footbrake mounted on the taper extension of the bridge line shaft, the torque reaction being taken by the end truck. This construction also relieves the girder of the terrific stresses which prevail when a crane operator uses his footbrake too violently. We recommend the installation of a brake on each end of the line shaft and since the brakes are of the hydraulic type simultaneous equalized braking is obtained and the stresses produced by violent application of the footbrake are almost wholly absorbed in

the end truck. Only the inertia stresses of the bridge motor armature being transmitted to the girder.

In conclusion I would emphasize the use of proper oil seals. There are many rawhide seals in the market today which, when properly installed assures leak-proof construction, and performs the double function of keeping the lubricant in and dirt out.

I would also caution against the use of excessive amounts of lubricants, as this is one of the most frequent causes of oil drippage. As an example of proper lubrication I know of a case of several stock cranes which are lubricated once every three months and this lubrication is done under the supervision of the foreman. These cranes are equipped with worm drive on the hoist and trolley and spur drive in the bridge and anti-friction bearings are used throughout.

Lastly—Care should be used in the selection of the lubricant and the operating conditions and temperatures properly considered.

By E. C. CLEARY
Chief Electrician of the Toronto, Ohio, Plant of Follansbee Brothers Company.

The spoilage of finished material due to the dripping of oil and grease from overhead cranes and runways has been the subject of considerable discussion among steel mill officials, particularly those concerned with finished and semi-finished products.

At the Toronto plant of Follansbee Brothers Company this trouble has been experienced quite frequently and was more pronounced in the summer months than in cold weather.

Several methods of eliminating this difficulty were tried, with a varying degree of success. Drip pans were constructed and placed under all track-wheel and line shaft-bearings, and a large sheet iron pan was placed under the bridge and hoist motors. While these precautions helped to some extent, they did not reach the real seat of the trouble, and our next step was to experiment with various grades of grease, with the thought that if the lubricant could be retained in the bearings at varying temperatures, that the drippings would at least be reduced to a considerable extent. But at this point the ever-present human element entered into the situation. Even though the precautions which had been taken produced a noticeable effect, the effort put forth was practically nullified by the failure of crane operators to properly care for the excess lubricant that became lodged in the drip pans, with the result that this difficulty would re-appear at certain times, particularly on an unusually hot day.

Our next step in the elimination of this drippage—and perhaps the one that produced the most noticeable effect—was the installation of roller bearings in crane motors. The amount of lubricant required for roller bearings on crane motors is very small as compared with the ordinary sleeve bearing, and by using a lubricating schedule the possibility of drippage will be practically eliminated.

While the foregoing comments show some of the difficulties with which we have had to deal in our attempts to eliminate this trouble, it might be well to mention at this point that all our cranes were designed and built about twelve years ago, and no consideration was given to the difficulties that we might encounter with respect to oil drippage. It is advisable, therefore, when purchasing new crane equipment for finishing departments in steel mills to select a design that will prevent oil and grease drippage.

We have installed roller bearings on cranes in finishing departments quite extensively, and we have applied special grease cups and central lubricating systems to certain other bearings. However, the track-wheel journals cannot be equipped without involving considerable expense, and these parts are still somewhat troublesome from the standpoint of lubricant drippage, especially in our finishing departments.

By W. C. HEINLE
Engineer, Cleveland Crane and Engineering Co., Wickliffe, Ohio.

During the last year or two we have been experimenting on gear cases quite extensively. About two years ago we designed a gear case which has no machined surface and in which we use no packing and it has worked out very satisfactorily. We also have applied it to track wheel gears where gear is between bearings alongside the track wheel. Of course it requires a little more space between track and gear and where you have close clearance it does take a little longer shaft. But in very large installations we make a heavier shaft and have the larger bearing on the receiving side. We have applied this type in textile mills and several other cases where it was essential that oil would not drop, and it has given very satisfactory results. For quietness of operation, we have used solid herringbone gears running in oil and found that they are satisfactory. We have used herringbone gears on cranes where we wanted to get good speed reduction.

Naturally, our gear case as we have developed it is a very simple case, and when taken apart can be put together without any trouble of tacking or anything else.

By H. S. GRIFFITH
Cranes Sales Engineer, Shaw-Box Crane & Hoist Co., Pittsburgh, Pa.

In addition to steel and tin plate mills, there are many other industries and plants in which cranes are used, and where oil and grease dripping from such cranes has caused considerable inconvenience and damage.

Some of the more important of these are: paper mills, stone cutting sheds and quarries, ice plants, automobile factories, warehouses, foundries, printing plants, and food preparing and packing houses. The results of oil drippage range from spoiled or damaged finished product, caused by stains, etc., to danger to workmen caused by slippery oil spots on the floor. In power houses, which are usually kept very clean, the appearance of any oil that has dripped from a crane is objectionable because of the fact that cleanliness is considered so essential. In warehouses where foods, grain, or other articles are packed in cloth bags or paper composition containers, a few drops of oil or grease could cause serious damage. Other examples could be included, but they would be only additional reasons why it is practically universally essential that overhead electric travelling cranes be built to guard against the drippage of grease and

oil on machinery or products over which they operate.

It is useless to dwell upon the results which might be caused by oil or grease dripping on unfinished steel sheets. Nor is it my aim to try to tell you the evils of oil and grease dripping on finished tinplate. No doubt you all are already too familiar with these subjects.

My consideration of this subject is from the angle of one who has been directly connected with the operation, manufacture, and sales of electric travelling cranes for the past thirty-six years in and around the Pittsburgh district. I have spent many an hour endeavoring to eliminate oil leakage after installing one of the old type open gear cranes.

When one considers the design and construction of cranes as built thirty or forty years ago, numerous reasons present themselves why grease and oil leakage was not only common, but practically unavoidable. First, we must realize that the crane as built then was such an improvement over the old type of flying rope crane that a small evil like oil leakage was of no account.

Open gears were used for years. Oil was poured on these, and naturally found its way to things below. Poorly fitted gear cases followed, giving storage space for more oil to eventually splash and leak out. Loose fitting inspection hole covers provided an opening through which oil could be thrown out by revolving parts.

Probably one of the chief causes for oil drippage from old cranes was the fact that proper facilities for greasing were lacking. Many cranes were built without safety platforms—in fact some of the very early cranes had no footwalk at all—and in order to grease the bearings, the operator was obliged to walk the girder and get down on the cross-shaft. This was a troublesome and hazardous proceeding, and it was only natural for the operator to say to himself "a little grease is good, but more is better", with the result that the surplus usually dripped on whatever was placed below.

The use of chains was another cause for surplus lubricant. Chains required grease, a large portion of which was gradually squeezed or shaken off and added to the troubles below.

The old style mechanical load brake was another offender. The first load brakes were built with the necessity of friction and heat being minimized by the use of a lubricant. This was because no friction surfaces were available to withstand this service. In order to perform its function, the lubricant had to withstand rather high temperatures. The result was that without exception load brakes were among the most serious offenders of the efforts to prevent cranes from leaking oil.

The old style waste and oil boxes under the bridge truck wheels were also serious offenders. Tight fitting waste and oil boxes were used in an effort to eliminate the trouble, and in some cases caps were fitted over the ends of the axles, but where the bridge driving gears were overhung a space still remained through which oil could gradually work out and drop to the runway.

In conjunction with M. C. B. waste and oil boxes, let me say that in a great many cases the blame for oil leakage can be blamed directly on the improper manner often used in preparing waste for this use. It is unfair to lay the blame on the design of oil box when in many cases the trouble could be eliminated by properly treated waste. My experience has taught me that it is a common occurrence to dip dry waste into a pail of oil, partly wring this out, and then stuff into the bearing box. This procedure results in too much oil and unsaturated waste, a combination which allows oil to run through the bearings faster than necessary and faster than can be taken care of. Waste should be soaked in a bath of oil for at least a week, and then allowed to drain on a screen for two weeks, being turned over from time to time. Care should be taken not to stuff the waste into the boxes too tightly because it deadens the springy action and consequently soon forms a solid mass which prevents lubricant from working up through it.

Needless to say, cranes as built years ago were not masterpieces of mechanical construction. Roughly cast and machined parts were acceptable. Ample strength and a large factor of safety were preferred to super-excellence of appearance and exact duplication of parts. This is not in any way an assertion that those cranes were poorly built, for their long years of constant heavy duty operation are sufficient proof of their dependability. But such construction was not the best from the oil leakage standpoint. Grease and oil bearings, poorly fitted gear cases, etc., while satisfactory for proper operation, were not conducive to prevention of oil leakage, and while acceptable at first, were gradually improved to eliminate the latter evil.

Another reason for needless oil leakage was the use of improper grades of lubricant. It was not so many years ago that oil was oil and grease was grease, and the use of such was accepted as proper for all purposes. This resulted in many improper applications, as we understand them today, of oils and greases of the wrong consistency.

To counteract the drippage faults in the old style cranes, builders competed with one another with continuous improvements. Drip-pans and catch basins were mounted under some cranes to prevent dripping of oil, but this practice did not prove satisfactory and was condemned in many places by safety committees. Gear cases were used, and in many cases cast integral with the trolley frames. Up-to-date cranes have totally enclosed gear cases, either of cast metal or welded steel with carefully milled oil tight joints. Such gear cases perform the double duty of preventing the leakage of oil and excluding the entrance of any dust or foreign matter. In addition to the tightness of the joint, additional steps have been taken to prevent oil leakage, such as proper contours within the case to cause oil to drip away from the side walls, and drainage grooves to catch any oil that starts to leak through the joint. Inspection plugs in gear cases are now threaded and fit into tapped holes. By the use of these precautions, gear cases on cranes can be made today perfectly oil tight, and these types of gear cases are universally used by the manufacturers of the best cranes.

Because of the improved materials now available for brake bands and discs, practically all the troublesome points of mechanical load brakes have disappeared. The special woven, oil resisting, surface ground friction discs which are now available are

able to give the desired friction with very little wear. The important feature, however, to this assembly, is that these discs operate most efficiently with a very small quantity of light machine oil, so the old time trouble of oil leakage from mechanical load brakes has been eliminated.

Present day methods of dressing crane cables practically eliminates the possibility of oil leakage from that source.

The use of anti-friction bearings has aided greatly in the elimination of oil leakage. Less oil is necessary to lubricate anti-friction bearings, and their application provides better means of preventing oil leaking out along shafts. In fact, the anti-friction bearing is the main reason why oil tight gear cases are now standard equipment on all types of machinery.

It is now common practice to use greaseless bearings in places where end thrusts must be taken care of, but where pressures are not high. These are being used with success in such places as truck wheels and collectors. The greaseless bearing is so called because of the use of graphite which is baked in place in whatever shape necessary, and which is self-lubricating.

Improved oils and greases have aided the builders of all types of equipment in overcoming their lubrication difficulties. The use of proper grades of oil allows smaller quantities, less frequent applications, and yet produces better results than was possible with oils and greases of thirty years ago. These advantages are additional reasons why oil leakage on cranes today is practically eliminated.

In direct contrast to the inconvenience of oiling the old time crane is the extreme accessibility of present day cranes, both as to maintenance and replacement of parts. Operators of up-to-date cranes take pride in keeping their equipment in first class condition and appearance. The effort necessary to lubricate the moving parts has been reduced to a minimum. Foot walks with hand rails are provided, and all lubrication points are easily accessible. For this reason cranes receive better care, the proper quantities of oil are used, and any excess wiped off to prevent leakage. This one thing has probably done as much as any other in eliminating oil leakage.

Hydraulic bridge brakes, with their concealed tubing, have taken the places of mechanical brakes, thus eliminating the necessity of brake rods and links which needed lubrication.

An improved method of lubricating roller bearings of rotating axle bridge wheels, whereby grease is forced to the bearing through a hole drilled in the pin is also worthy of note in that it eliminates the possibility of the lubricant being pumped out by the end motion of the wheel.

Several of the most important improvements have taken place, comparatively recently. There are many times more old style cranes in use than there are modern ones, with the unavoidable result that many crane users continue to be inconvenienced with oil and grease drippage. Crane equipment as a whole throughout the country is probably in worse condition than is any other single line of shop equipment, regardless of the fact that crane builders have kept step with improvements made on other lines. As a representative of the crane manufacturers, I have no hesitation in saying that oil and grease leakage from cranes, as well as other troubles experienced in old designs, have received the utmost consideration of of crane designers, with the result that cranes as built today are a worthy product of the modern engineer.

By A. F. BREWER and E. A. HARPER
Mechanical Engineers, The Texas Company

Operation of overhead traveling cranes in steel mill service, in the interest of preventing loss of lubricant therefrom and contamination or spotting of sheet steel products during the process of handling, is one of the outstanding problems which has confronted the lubricating engineer for many years.

The effects of oil or grease upon such products, regardless of their gauge, is far reaching. Grease or oil, after it gets on a sheet while the latter is hot, cannot be entirely removed, even in the annealing process. And yet, full finished sheets, or sheets for coating, must be entirely free from grease or oil spots. Pickling thus far has proved unsatisfactory in removing these spots entirely. Sheets to be coated by galvanizing or tinning must be free of scale, and this cleaning is accomplished by pickling. The various acids used will remove scale, but will not remove grease or oil. Dripped oil or grease will also cause pinched or ruffled edges, if the steel is thus contaminated in the process of rolling.

It is also important to consider the safety factor. Even though the saving of product should not be sufficient to justify the entire elimination of oil and grease drippage from overhead equipment, regard for the personal safety of the workmen involved will justify every effort that is put forth to reduce this evil to an extreme minimum.

Sheet steel should furthermore be free of spots regardless of whether the process within the mill itself would be impeded due to their existence, in view of the fact that the customer may have a desire ultimately to paint the surface. This applies even to common sheets.

The extent to which dripping of lubricants may occur will, of course, depend upon the design of the equipment. In some of the most modern installations of overhead electric cranes, it has been noticed that it still prevails, although not to as great an extent as in older types of machines, due to the fact that equipment manufacturers have given considerable thought to this feature in design and construction. It still remains, however, as a potential detriment and in most cases it can be attributed directly to one of three causes, namely, excess application of lubricant, use of improper lubricants, or carelessness in handling lubricants during the process of application.

In view of the fact that there are any number of plants still operating equipment of the older type, it has been necessary for the management of such plants, in collaboration with the engineers of various manufacturers of lubricants and lubricating devices, to devote a great deal of time and thought in order that the deficiencies of such equipment may be overcome, to bring about competitive production from a manufacturing and marketing standpoint.

A variety of methods prevail for the lubrication

of overhead machinery, with none as yet really standardized. There is, however, considerable attention being given to the matter, both by equipment manufacturers and lubricating engineers, in co-operation with the operating and maintenance departments in many steel mills, for the purpose of devising ways and means to prevent the loss of lubricants as far as possible.

It is a distinct problem in many plants, by virtue of the wide range in operating temperatures which prevails, and the tendency of certain types of lubricants to creep, and ultimately drip from the lubricated parts. High temperature work has the effect of reducing the viscosity of lubricating oils, or the consistency of greases, oftentimes to render them so fluid as to require the most carefully designed seals or housing devices to enable their retention. For this reason the trend has been toward heavier oils and harder greases.

Where oil is employed, waste, felt, or some other absorbent material may be used to take up the excess lubricant after it has seen service. It is also practicable to install drip pans. Unfortunately, however, these latter will require periodic emptying. Saturated waste or felt will also have to be removed, otherwise it will fail to serve its purpose.

It is fair to state, however, that all of the oil and grease damage to sheet steel should not be charged directly to drippage from cranes and their runways, nor to the negligence on the part of the crane oiler or operator. In japanning or enameling of furniture, or other full finished stocks, a small particle of oil saturated dust, even as minute in size as a pin point, falling onto the sheet after pickling, and before it goes into the annealing box, will expand into a discoloration sometimes as large as a ten-cent piece or a quarter. This is due to expansion of the vapors which results when certain petroleum products are subjected to annealing oven temperatures.

Crane Truck Bearings

Truck bearings of the MCB type, lubricated with oil-saturated waste packing have always been a prevalent cause of oil drippage, not only down onto the product, but also onto the runway and the supporting structural members. This latter condition creates a hazard to the personnel involved which is worthy of great consideration. Careful study has resulted in the conclusion that the use of waste and oil can be discontinued in favor of grease, using a product of semi-solid or comparatively solid consistency. In many plants such a procedure has led to virtually entire elimination of drippage.

In some installations the grease is placed in specially designed pans and held against the journals by means of springs fitted to the underside of the pans. Experience has indicated that this type of lubrication will last for a long time, only requiring attention when regular inspections are made.

Another method of keeping the grease in close contact with the journal is to use a weight and lever device, as shown in Fig. 1. In such a device the grease container is from 2½ to 3 inches wide, the length being the same as the bearing, in order to insure that all the bearing surface is in contact with the grease. Pressure can be regulated according to the temperature at which the element is operating, by adjusting the location of the weight on the end of the lever.

It is important to remember, however, that should carelessness prevail, even in the handling of grease while it is being applied to the journal boxes, there is a chance that some of it may drop down later onto the runway and perhaps the product below. This will also apply to the truck bearings of the trolleys, for the MCB bearings on them are treated exactly as are the bearings on the bridge proper.

Where cranes are to operate continuously, over open hearth furnaces or annealing ovens, it will be essential to resort to a grease of comparatively high melting point, in order to prevent undue reduction in consistency and obviate the possibility of separation.

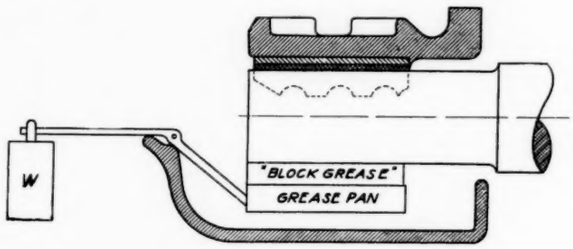

FIG. 1

Grease lubrication is also practicable on cranes equipped with roller bearings. Normally these latter can be more tightly sealed than the plain or sleeve type bearing. On such elements a medium consistency grease of high melting point, containing an oil which has a viscosity in the neighborhood of 175 seconds Saybolt at 210°F., will serve the purpose effectively. It is important to remember, in the use of such a grease, that the consistency must be such as to enable ready application with a hand operated grease gun. As a general rule, the same type of lubricant can be used on all anti-friction bearings on the average crane. The melting point of such a product should be in the neighborhood of 300°F., or higher, and it should indicate absolutely no tendency toward separation.

Gears and Pinions

The lubrication of gears and pinions depends entirely on the arrangements to keep them lubricated. Where cases are used to enclose these elements, it has been found that the smaller the amount of lubricant used to meet the conditions, the less trouble is experienced. After the teeth are coated very little gear lubricant is required to keep a film on the teeth. The distance between the gear case and the gear or pinion should not be over ½ inch; ¼ inch would be the minimum, inasmuch as sufficient gear lubricant can be carried in a case with such clearance. Furthermore, when this small clearance is used, the drag on the gear or pinion is kept down to a minimum, as well as the leakage, which in turn would lead to dripping.

For such service a straight mineral lubricant, having a viscosity in the neighborhood of 1000 at 210°F., will normally meet the requirements, where gears and pinions are so housed as to prevent leakage of the lubricant. Should leakage be possible,

however, it will be advisable to give careful study to the matter of raising the viscosity of such a gear lubricant, depending upon the type of housing. Frequently in non-oil-tight housings it will be best to apply the lubricant by hand, and guard against any undue accumulation of lubricant in the base of the housing, to result in possible leakage. This will require the use of a product of ten-times as high as 5000 seconds Saybolt at 210°F.

It is important to remember, however, that in dealing with a lubricant of such high viscosity the congealing effect of low temperatures may lead to a decided increase in power consumption, particularly on starting.

Wire Rope

Wire rope lubricants cannot always be used with positive satisfaction, in view of the wide range of temperatures to which such ropes are exposed, and the fact that they are in direct line with the materials being handled. As a result, any dripping of lubricants from such elements would most assuredly reach these materials. For this reason, best practice would be to specify that the cores of the ropes should be treated during manufacture with a lubricant of heat resisting characteristics.

Furthermore, it should be free from all fillers. Where a rope core has been treated with a lubricant of this type, the latter will work its way from the core, through the strands of the rope, not only to give additional life, but also to prevent premature corrosion and rusting. It is important to remember that as a wire rope is worked back and forth over the sheave wheels, any contained lubricant within the strands may work out and deposit on the wheels, which might lead to throwing off.

Bearings

In view of the fact that sheave wheel bearings are usually of the sleeve type, they can be effectively lubricated with grease by means of a hand operated grease gun. The amount of lubricant necessary to meet such requirements is comparatively small and gun applications should be carefully controlled in order not to deliver too much lubricant. Otherwise, it might find its way out to the ends of the bearings, to drip and cause trouble.

Other sources of drippage are the back axles and the line shafting. While these are usually equipped with an industrial grease fitting of some type, it is generally the practice of the operator to consider that if a little bit of grease is good, a whole lot will be better and, as a consequence, an extra portion is applied.

Motor bearings may also cause similar trouble. If the cavity for lubricant is filled to excess there is bound to be a drippage and, in the case of the trolley motors, due to their passing back and forth over the product being manufactured, there is likely to be damage to the product. Care should be taken in the selection of the lubricant for these bearings, as well as its application. It might be remarked that in most cases that have come under observation, dripping has been due to the tendency to keep motor bearings clean by flushing out with excess lubricant and the desire of the workman to prevent hot bearings and avoid criticism. The same premise holds true in connection with anti-friction bearings using grease lubrication.

The manufacturers of lubrication equipment have given considerable thought and time to the development of centralized lubrication equipment, which once installed and properly adjusted will assist greatly in almost complete elimination of dripped lubricant, from overhead equipment. This class of lubrication equipment also greatly reduces the personal hazard.

Parallelling activities have been outstanding in the research studies of the petroleum industry. Our company, in particular, has spent considerable time and effort in the development of suitable greases to meet high temperature conditions, capable of application through centralized lubrication systems with the utmost economy.

In summary, it might be said that proper selection of any such lubricant, careful application after it has been selected, and the installation of suitable guards to prevent loss through dripping, will eliminate, to a great extent, the product loss due to drippage of oil and grease during the process of manufacture, and increase the factor of safety from a personnel standpoint.

By JAMES FARRINGTON
Supt., Elec. Dept., Wheeling Steel Corp., Steubenville, Ohio.

The only thought I would like to give to the assembly here is the possibility of limiting the amount of grease applied to a bearing by the temperature of that bearing. We are now installing in two of our anti-friction bearings, on an electric overhead crane, a thermostat which will give a warning to the operator when these bearings have reached a predetermined temperature. We will operate the crane until the thermostat functions, then examine the bearing and, if found in good condition, we will raise the setting on the thermostat, but add no additional grease, and proceed as before, and, in this manner, determine how long a bearing can operate satisfactorily on one application of grease, based on a safe temperature. We know, as one of the previous speakers mentioned, that the cranemen do not want to be censured for hot bearings and are greasing the bearings much oftener than is required.

By MAURICE RESWICK
Chief Engineer, Pennsylvania Lubricating Co., Pittsburgh, Pa.

The evil of drippage of lubricant from overhead cranes is a heritage from the time when it was customary to give lubrication only casual attention in machine design. Wherever you have waste-packed bearings, open gears and screw-type grease cups, you have to contend with the evil of drippage and leakage of greases and oils, particularly when the correct lubricant is not used.

Modern design of overhead cranes calls for grease-sealed ball or roller bearings on all possible points from the motors to the wheels, including even the vertical thrust bearing on the hook. The approved practice is to fill anti-friction bearings only from ¼ to ⅓ full, and if this is observed, there should be no leakage. In general, a deficiency of lubricant in an anti-friction bearing, especially when operated at high speed, such as in motors, is better than an ex-

cess. Only enough grease, of the proper type, should be put into the bearing to coat the balls or rollers and the races. When packed full, there is a possibility of the bearing running hot on account of churning and generation of internal friction in the lubricant, causing the grease to become soft and be thrown out of the bearing.

The gear trains in cranes of modern design are, or should be, all enclosed, with suitable packing or seals at the shaft ends. As an additional precaution, it is advisable to use as heavy a lubricant, consistent with the speed of the gears and their size, as possible, so that creeping of the lubricant past the packing will be reduced to a minimum. The more general use of worm gearing on cranes has simplified this problem considerably.

On cranes older than five years, the original provisions for lubrication are no longer adequate, and the mechanical or maintenance department in each plant has a standing order to rebuild the bearings—replacing them with ball or roller bearings, or changing their design so that lubrication will be more efficient and so that the spoilage of material underneath the cranes and runways will be eliminated. Open gears can be enclosed in welded sheet metal guards, and considerable ingenuity is required to make a neat job.

The problem of prevention of leakage of grease and oil from overhead cranes, referring particularly to older types of equipment, is largely a mechanical one. The lubricant manufacturer and lubrication engineer can help along, but it is a mistake to rely entirely on a change of lubricant. The problem must be attacked at its source, which involves mechanical changes and improvements.

Assuming that everything has been done in a mechanical way to stop leakage of a bearing, the next step is to select the proper lubricant, preferably one that possesses anti-leakage properties, that would stay put in place and not creep out through any unavoidable clearance between the shaft and the bearing.

A lubricant to meet these requirements in addition to maintaining a strong lubricating film between the rubbing surfaces, should possess unusual cohesiveness, tenacity and anti-drip properties.

A lubricant of this type is now available in several consistencies for the lubrication of overhead cranes. The light density may be used in ring-oiled electric motors, the intermediate grades for saturating wool yarn elastic used in the oil cellar boxes of the M. C. B. type, while the heaviest grade is ideal for use in pressure systems as well as in grease guns for application to bearings equipped with high pressure fittings.

I am not in a position to give you a complete analysis of this type of anti-drip lubricant, except to say that it is composed of highly refined mineral oils to which specially treated aluminum soap is added. In the lighter grades they are of a golden color and have the transparency of mineral oils. If you put a drop of this type of lubricant between the tips of your thumb and the first finger of your hand and pull the fingers apart, you will find that the drop of lubricant can be drawn out into a string or a bundle of spider webs of considerable length before rupture. Of course, the heavier the consistency, the more pronounced will this property of stringiness be. It is self-evident, therefore, that a lubricant having these properties will resist considerable centrifugal force, and that it will not drip out of a bearing as readily as a straight mineral oil or a light grease. The usual precautions of not overfeeding the bearing must, of course, be observed even with lubricants of the described type.

Where leakage is due to high temperature conditions such as encountered when an overhead crane is run over annealing furnaces, over soaking pits, open hearths, etc., another type of lubricant should be selected which possesses high temperature characteristics.

Where ball or roller bearings are used, they should be packed with a soda base grease especially prepared to withstand temperatures as high as 210° F. in constant operation. Such anti-friction lubricants are readily available.

On plain truck and trolley wheel bearings, it is advisable to replace the wool yarn with a semi-plastic, putty-like grease which has an exceptionally high melting point. In most cases it will be necessary to support the grease against the journal by means of a light spring, particularly where the journal is lubricated from underneath, as is the case on most wheel bearings on older installations.

By A. J. DREYER
▲ Dist. Sales Mgr., Harnischfeger Sales Corp., Pittsburgh, Pa.

The escape of oil or grease from bearings and gear cases on overhead mechanical and electrical equipment has always been something of a problem in those plants where appearance of product is highly important. Sheet and wire mills, paper, glass, marble, food, brass, copper and aluminum plants have all been obliged to give attention to this annoyance.

Overhead electric traveling cranes have perhaps required more attention on this score than any other type of overhead industrial equipment. There are two important reasons for this fact.

1st. In the case of a crane or cranes installed in an industrial department, the lubricated bearing and grease or oil filled gear cases traverse practically the entire floor area.

2nd. Cranes of this type have all their functions reversible. It will be well to keep this characteristic in mind, since reference will be made to it later in this article.

Bridge and Trolley Truck Axle Bearings

First class crane specifications as drafted today are likely to mention and require roller bearings throughout the entire crane, but the fact remains that most cranes in operation today are provided with sleeve type shaft bearings, and the motor armature shaft bearings are of the same type. Mill cranes and high duty industrial cranes are invariably provided with M. C. B. type bridge and trolley axle bearings, oil waste lubricated. Until the advent of the roller bearing, this type of M. C. B. axle bearing was highly satisfactory in the matter of simplicity, accessibility, initial cost, and ease of maintenance, but it was probably responsible for the escape of more lubricant than any other type of bearing in common use today after it developed a

modest amount of wear, particularly on the inner flanges, which restricted lateral movement of the truck wheel axle. In the case of new equipment, the clearance between the face of the truck wheel hub and the M. C. B. flange is likely to be much less than 1/8", but at the end of a year this clearance might easily be more than doubled, with the result that lateral movement of the axle in the bearing developed a wiping effect between the bearing and the axle, and the oil wiped off the axle ran down the ends of the M. C. B. bearing, and in the case of the trolley axle bearing was deposited on top of the bridge girders, and in the case of bridge trucks was deposited on the runway.

Lubricant escaping from trolley truck wheel axles was particularly annoying, since most of it eventually found its way to the floor or the ground, and the only way this could be eliminated in a measure was to provide drip pans below each trolley axle bearing, and likewise make provision for removing from the top bridge girder cover plate whatever lubricant was not caught by the drip pans. It is quite needless to say the drip pans require frequent cleaning.

Workmen or oilers delegated to renew the lubricant and wool waste in M. C. B. oil cellars are, of course, expected to avoid the use of too much oil.

Another reason for escape of oil from an M. C. B. type of bridge and trolley axle bearing is frequent and violent contact with wheel chocks at the end of the bridge girders and runway rails. Violent contact tends to force the axle slightly out of the M. C. B. bearing, and when it drops back into place the lubricant on the face of the bearing and on the face of the axle is driven violently out of the bearing in a direction parallel to the axle. Also, if drip pans are mounted below the axle bearings, some of the oil in them will probably be spilled during this violent wheel contact.

Hoist Cables

Lubrication of hoist cables will increase their service life, but such lubrication must be of a sort that will penetrate between the strands and individual wires forming the cable, and this implies that lubricant used must have penetrating qualities, and must flow with some freedom. Twenty-five (25) to thirty-five (35) cable diameters for cable sheaves and hoist drums are about the limit on cranes and hoists, and these diameters require sufficient bending of cables to produce friction between individual wires and strands. This friction can be substantially reduced by lubrication, but a lubricant suitable for these conditions simply cannot be kept on the cable. Any such lubricant is certain to fairly envelop the hoist drum and cable sheaves, and since with light loads or light hook the drums and sheaves attain fairly high R. P. M., the centrifugal force will cause some of this lubricant to be thrown off and reach the machinery and product below the crane. In cases where escape of lubricant from an overhead crane is particularly objectionable, we believe it proper to operate cables and hoist drum grooves without lubrication.

An application of something like hot crater compound or boiling of hoist cables in linseed oil before placing in service is sometimes resorted to, and no doubt has some value, but it is usually expected that a hoist cable will have a life of several months at least, and if an effort is made to afford lubrication by means of a more or less dry lubricating element, such as mentioned, it can scarcely be expected it will be effective 90 or 100 days after application.

Trolley and Bridge Shaft Bearings

It is well here to remember that more than 90% of all cranes in use today have their various shafts provided with sleeve type bearings, and we must recognize the fact such bearings in the case of mill cranes and other high duty cranes are subject to appreciable wear and replacement. We can also readily believe that a bronze sleeve type bearing on a 4" diameter shaft will not be replaced by the crane maintenance department until the clearance between the shaft and the bore of the bearing has increased by reason of wear to 1/16", and in many cases almost 1/8".

These bearings invariably are grease lubricated.

We now come to the characteristic mentioned in a paragraph above as being important in connection with overhead electric traveling cranes and the escape of lubricant, namely, the fact that all of their functions were reversible.

In the case of a 4" diameter shaft and a somewhat worn bushing, also the shaft in question carrying a pinion immediately adjacent to this worn bearing, picture to yourselves what happens when this shaft is violently reversed. With the shaft turning in one direction, the reaction from the pinion causes the shaft to ride in the bottom of the bearing, and when it is reversed the shaft was riding in the top of the bearing. This reversing action may average two cycles per minute, and continues throughout the entire working shift, and after the bearing has attained some wear, very little grease lubricant, or oil for that matter, can be retained on the bearing surfaces for any length of time, since lubricating particles are being forced out of the ends of the bearings by reason of the shaft being thrown from one side of the bearing to the other.

In the case of a newly fitted bearing on a shaft in reasonably good condition with the clearance restricted to something like 1000th or 2000ths of an inch per inch of diameter, this condition is not pronounced, and could easily be ignored.

The objectionable characteristic above mentioned can be somewhat reduced in the case of a bearing at the end of the shaft having the outer end closed.

Such a bearing or bushing is frequently referred to as a cup bushing or cup bearing.

The reversing action mentioned will still cause lubricant to be thrown out of one end of the bearing, but the inner end is usually inside of a gear case, and lubrication forced out of this end at least remains in the crane.

This practice of using cup bushings cannot be resorted to in all cases, however.

It is pertinent here to mention the case of mill type crane motors with pinion mounted directly on the end of the armature shaft and revolving in sleeve type bearings which have developed an appreciable amount of wear. Such worn bearings in the case of reversing crane type motors are a prolific source of commutator and field coil destruction, by reason of particles of oil forced into the motor frame through slapping of the armature shaft back and forth in the

worn bearing when the motor is reversed, or when the motor brake is vigorously applied.

It is true that all well designed motor armature shaft bearings of the sleeve type are provided with oil retaining features, which are almost 100% effective, with well fitted sleeve type bearings, but after the bearings become worn and under the influence of reversing action, the disturbance of the oil inside the bearing becomes so violent that small particles are certain to escape along the shaft.

Gears and Gear Cases

A very large portion of the cranes in operation today have all of their gearing more or less completely enclosed in steel cases, and these cases if made of welded sheet metal have the joints well lapped, or provided with some sort of packing material, although the packed joint is somewhat objectionable, since it requires occasional replacement, and the case is likely to leak badly if it is neglected.

The second type of case is made from heavy cast sections, preferably cast steel, with the joints accurately ground, and gears operating in such cases are well lubricated, and there is really very little escape of lubricant from these portions of the crane.

All of the objectionable circumstances and conditions mentioned in this article can be improved upon immensely by substituting any one of a number of excellent roller bearings or ball bearings, grease lubricated, and provided with some of the tested and really effective means of preventing grease from escaping.

The most important lubricant retaining feature of the roller bearing is the fact that if reasonably well applied, and not overloaded, it will operate for long periods of time without any appreciable wear, and this absence of serious wear makes it possible to apply various lubricant retaining features which remain effective for long periods of time.

However, even though we resort to roller bearings throughout the entire crane, we must reconcile ourselves to the fact that no overhead electric traveling crane can have all of its oil and grease receptacles tight enough to prevent absolutely the escape of any of the lubricant.

By S. A. NEWMAN
Chief Lubrication Engineer, Gulf Refining Co., Pittsburgh, Pa.

The correct lubricants, properly applied on overhead crane bearings and cables, will prevent spoilage from this source.

We have found one of the most satisfactory methods of lubricating the journals which support the bridge and trolley is to pack them properly with a good grade of wool waste which has been saturated with a high viscosity, specially treated oil. Make-up oil should be applied by way of wick feed or sight feed cups, using a high quality, cold tested oil of approximately 2,000 viscosity at 100°F. It is surprising what a small amount of oil will be needed for make-up when an oil of this viscosity is used. With reasonable care, trouble will not be experienced with oil leaking from the bearing housings.

We find most line shafts driving the crane fitted with pressure gun fittings or with compression grease cups. In most cases we do not believe this is the best recommendation. We recommend the installation of gravity feed pin cups to feed a specially prepared semi-fluid grease. This not only gives excellent, economical lubrication, but does away with the hazard of forcing excessive grease out of the bearings which may later drop on material being handled.

Assuming the crane is being driven by motors using ring oiled bearings, we usually recommend that an inexpensive device which is being sold under the trade name of "oilits" or some similar device be installed to keep the oil at a constant level. The glass container can be filled without wasting oil or spilling and thus prevent oil from being poured into the top of the bearing until it runs out of the shaft and into the motor windings.

The reduction drives are mostly enclosed, bath lubricated, and should not offer any trouble from the standpoint of our discussion. When open spur gears are encountered, they should be lubricated with a heavy gear lubricant applied hot. A metal shield properly fitted will prevent contamination from the lubricant.

The wire ropes should be impregnated with a heavy cable dressing, applied hot, before being installed. A grease or black oil should not be used on a cable. As an extra precaution, a metal shield can be fitted below the sheaves on the hook.

The pins on the sheaves should be lubricated with a high melting point grease made from a high viscosity oil.

By JOHN L. YOUNG
District Manager, Industrial Division, Timken Roller Bearing Co., Pittsburgh, Pa.

Several statements have been made so far that seem to require further explanation and discussion.

Mr. Farrington has referred to the use of a thermo-couple in each bearing housing of his crane to study the possibility of bearing temperature rise as a determining factor in the establishment of a period for re-lubrication

It so happens that about two years ago this idea was tried out in connection with some roll neck bearings on a hot strip mill in the Chicago district and that system is still used. During that time they have learned a number of things in connection with bearing temperatures and lubrication and can readily stop trouble by any marked or sudden rise of the indicator. The application of this system to a crane is entirely new and Mr. Farrington's results should be of interest.

Mr. Reswick has mentioned that the bearing chamber should be filled about ⅓ or ¼ full of grease for proper lubrication. This raises the question of knowing just when the housing is properly filled with lubricant as the man doing the lubricating is generally working without any knowledge of exactly how much grease is left in the housing, so that some method should be installed for the proper regulation of lubricant.

In connection with this same mill described previously, it was found advisable to install at the uppermost point of the bearing chock a vent plug consisting of nothing more than a common pipe plug drilled two ways and the outlet pointed downward so that any water or dust or dirt that might fall downward would not have a tendency to enter at

that point. In connection with the thermo-couple and the vent plug, it has been learned that a very close check of bearing lubrication can be maintained and the vent plug alone serves as the best tell-tale.

As long as the bearing is operating, grease can be forced into the housing until it starts to sputter from the vent plug. At that time the addition of lubricant is stopped and if a little too much lubricant has been added, the bearing will automatically remove that lubricant through the vent by the pressure built up within the bearing chamber. Under these conditions of grease lubrication the bearing is operating in a bath of grease that is exactly right.

This vent plug has been applied to all recent installations of anti-friction bearings on rolling mills and has also been applied to cranes. It is more difficult to tell when the bearing housing is full on a crane as the bearing is not operating at the time of the forcing of grease into the bearing chamber but a little practice in this connection will allow the operator to know just about how much grease to add and prevent too much spillage through the vent plug.

This all has to do with the dripping and spillage of grease and oil. In modern bearing applications it is highly desirable to have an efficient seal. The old practice has been to force in enough grease until some of the old grease is forced out around the shaft. This is wasteful and generally leads to over-lubrication of the bearing which in turn may create heat and actual loss of lubricant through that heat or the possible loss of the bearing.

This brings up the point of the most effective seal. The most effective seal is one that holds the grease in the housing and at the same time keeps the dirt, water, or grit out and yet does not wear or score the shaft. So far from our experience, a felt seal in connection with applications of this sort is about the poorest of all. Felt should very seldom be used with grease lubrication. It is most efficient with oil lubrication and the applications being discussed today are principally grease lubricated bearings. If felt is used, it should be protected with one or more annular grooves in the closure surrounding the shaft in order that those grooves may become filled with grease and in turn pick up the dirt before it has a chance to get to the felt. The usual practice is for the felt to pick up both oil and dirt and form an abrasive compound which in turn scores the shaft and renders the seal ineffective.

There are other types of seals, such as those shown on the blackboard, including the cupped leather type seal. There are any number of companies now manufacturing seals of this type so that the reference made is not to any particular brand. Sketches were made to show the method of turning the cupped leather for grease or oil applications with the point of the leather out for grease and in for oil.

There are other types of seals, such as the metallic packing, manufactured by a company in Chicago, consisting of a flax backing and a surface of babbit metal. The fact that this surface is of bearing metal allows a certain pressure to be applied if properly lubricated so that a clock spring can surround the outside of the packing and tension can be applied by a set-screw arrangement. This closure has been very efficient and most effective in connection with roll neck bearings where the presence of high pressure water and mill scale is a serious factor.

In connection with crane bearings, this seal is undoubtedly a little too complicated and too expensive for the requirements, so that the most economical and best seal is undoubtedly the seal made of rawhide described previously.

These modern and effective seals are tight around the shaft and because of that tightness it is all the more necessary that a vent plug should be applied in order to allow the release of any pressure that might be built up by the forcing of grease into the bearing housing. The tightness of these seals, of course, insures the reduction of dripping and spillage of grease and oil on the finished product, which is the subject today.

By B. HANTMAN
Plant Engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

During the past five years great strides have been made in the design of cranes, particularly that phase which includes the use of anti-friction bearings, properly designed gear cases and good joints in order to solve this problem.

With these later cranes we have no trouble due to dripping of oil or grease. However, I would like to find out how we can solve the problem in a satisfactory manner on the older cranes which have been in service anywhere from ten to thirty years.

As brought out by previous speakers, we also use pans under bearings to catch any excess lubricant; and we have installed guards or casings over exposed gears. We then place the responsibility of keeping these pans and casings from over-flowing up to the operator of the crane himself. Where there is more than one crane on a runway we allow the operator fifteen minutes overtime to lubricate and clean his crane, and where there is only one crane on the runway he performs this duty during regular working hours.

By A. J. JENNINGS
General Sales Manager, The Farval Corp., Cleveland, Ohio.

The spoilage of materials caused by lubricant dripping from overhead traveling cranes, represents a direct loss in practically every steel mill and is a serious problem, particularly in the sheet mill.

The meeting today for the purpose of a general discussion and analysis of the corrective methods applied to overcome this difficulty at many different plants, is most timely.

During the past few years much has been accomplished through the use of a number of different remedies developed by those men of the steel industry who have constantly endeavored to keep this loss as low as possible.

Some of the effective steps taken to correct this difficulty, include the following:

1. Instead of packing the MCB journals with waste which has been literally soaked in oil, to be followed by pouring a generous additional quantity into each of these bearings at irregular intervals, the excess oil has been squeezed out of the waste and then the waste placed into the bearing, followed by adding a small quantity of lubricant, at the regular intervals required to provide proper lubrication.

2. Another corrective step is the use of the very best lubricant to meet the individual conditions of service and to thus keep more of the lubricant in the bearings. In some plants a vegetable compounded lubricant has been used because this type of lubricant when it drips on to the material will pickle out in the pickling operation.

3. At other plants drip pans have been installed under each bearing to catch the excess lubricant and prevent drippage on to the material. Some plants consider the cost of this method excessive and difficult to make completely effective.

4. A further improvement has been obtained through the use of anti-friction bearings provided with the best practical seal to retain the lubricant. This has proven effective for many conditions of service, providing an excess quantity of lubricant is not put into the bearings, and where the heat does not act to thin out the lubricant sufficiently to reduce the efficiency of the bearing seals.

We believe that the fundamental cause of most drippage is excess lubricant that cannot and will not stay in the bearings and that if it were practical to provide each bearing with only the exact amount of the correct grade of lubricant required, this difficulty would, to all practical purposes, be eliminated.

The hand lubrication of a multitude of different size bearings on a crane, in an attempt to see that each bearing gets the proper quantity invariably results in over-lubrication. The oiler must provide a sufficient quantity of lubricant to take care of the bearing until the next time he can get around to it. The oiler is further handicapped because many of the bearings are difficult to reach by hand and crane lubrication is one of the real hazards in the average mill. The specialized care and responsibility thus placed on the man who does this work, in most instances surpasses his ability, with the result that whether the bearings are MCB journals, plain sleeve bearings or anti-friction bearings, they will always be given an excess quantity of lubricant.

The experience gained over the past several years and covering practically all types of bearings leads to the definite conclusion that any type of bearing will eventually give up its excess lubricant. With the sleeve bearing this occurs almost immediately, while the sealed anti-friction bearing requires a longer time for the excess lubricant to accumulate and produce drippage.

That many steel mill men have recognized the unmistakable urge of any man to over-lubricate, we feel is clearly evidenced by the installation of more than 300 of our individual centralized systems of lubrication, a large percentage of which are located in departments where the loss from drippage is a serious problem.

Our first installations provided a manually operated system with a fixed displacement measuring valve for each bearing, the quantity of lubricant delivered to the bearings being determined by the size of the valve. This provided a considerable improvement because it materially reduced the quantity of excess lubricant delivered to each bearing by the hand method.

In this type of installation, however, it was also necessary to provide some excess lubricant to insure proper lubrication between the operations of the central system.

Further experience taught that the conditions of service involved variations of speeds, loads, temperatures, etc., and that it was impossible to manufacture a sufficient variety of valve sizes to cover each set of conditions, let alone make a correct and exact selection for every bearing.

The next corrective step was to provide an adjustable valve for each individual bearing. This improved type of installation gave more accurate control over the quantity of lubricant delivered to each bearing, but with the hand operated pumping unit, it was still necessary to deliver a sufficient excess quantity of lubricant to carry over until the next time the system was operated.

In the latest development of our equipment for crane lubrication, a full automatic central pumping unit, synchronized to the operation of the crane itself, has replaced the former hand operated unit.

With this type of installation an adjustable valve at each bearing automatically delivers an adequate quantity of lubricant at regular intervals and no excess quantity is required.

Also by this method the exact amount of lubricant required to maintain the proper film in all bearings, at all times, is obtained.

One automatic pumping unit is operated from a shaft on the trolley and a separate automatic pumping unit is operated from the line shaft on the bridge, thus each system is individually controlled and will start and stop with the crane itself. The control is entirely hydraulic, eliminating the use of any electrical equipment for timing the adjustable frequency of its operation.

This unit provides a simple low cost installation approaching the ideal condition of giving to each bearing only the quantity of lubricant required, and by the elimination of any excess quantity practically no lubricant accumulates to drip on to the materials below.

In making this contribution to the problem, we have been obliged to directly refer to a product of our manufacture. We have felt that this could not be avoided, because we believe that the use of our device constitutes one of the most effective preventatives for this trouble.

By G. W. MILLER
President,
American Lubricants, Inc., Buffalo, N. Y.

Of the many factors which may be involved in operation and maintenance of virtually any type of machinery, power consumption, maintenance cost, lubrication cost and cleanliness are of the most interest to the operator.

As you well know there is a direct tie-up between these factors and proper lubrication. However, proper lubrication alone cannot work miracles unless the lubricant can be applied to a well designed bearing in an economical and clean manner and by efficient workmen.

A poorly designed bearing from a lubricating standpoint not only causes lubrication difficulties and high maintenance costs, plus increased power consumption, but also waste of lubricant which in turn is a menace to the safety of the workmen and causes spoilage of finished products especially if this equipment is crane equipment.

Upon examination of a great number of cranes

operating in various mills we have found very few with bearings so designed that they can be properly lubricated without excess loss of lubricant.

In most cases they are just ordinary plain open sleeve type bearings out of which oil or grease naturally runs and drips.

Not to be too hard on the designers of this equipment in general, whom we think could really do a better job if some thought was given to lubrication before the equipment was built instead of building it and then trying to properly lubricate it, crane lubrication is difficult due to the unusual working conditions encountered, varied temperatures, speeds, loads, intermittent operation and weaving due to condition of road or travel.

In addition to this we must take into account the human element. We have found the general practice is to have the crane operator lubricate his crane before or after each trick. We believe this is wrong for as you well know the human equation is to play safe and over-lubricate.

It was found where wool yarn and oil or a combination of oil and grease was being used there was considerable drippage and waste of lubricant. Truthfully, and we believe you will agree, it is practically impossible to prevent this drippage when using straight oil and yarn in present equipment. However, if some one person in the mill was made responsible this drippage could be practically eliminated by the use of mineral oil compounded with the proper amount and type of fatty oil. This compound enables the squeezing out of all excess oil leaving the yarn practically dry. However, regular attention must be given bearings lubricated this way to see that the yarn is kept pushed up to the bearing.

We call your attention at this time to the journal bearings on railway equipment which are generally oil lubricated. These bearings are very similar to the truck crane bearings but you seldom see a greasy car wheel or grease along the railroad right of way.

This is due to the fact that some thought has been given to the design of the bearing. The box or cellar is so placed around the bearing as to completely enclose it, somewhat on the MCB type which has not gone quite far enough.

If you will examine one of these bearings you will note a much different arrangement of thrust collar and bearing on the wheel or shoulder of the shaft. It is so designed that a leather seal can be placed in behind the box which absolutely makes it oil or grease tight.

The leather fits or encloses the back of the box and is drawn or formed cup shape where the bearing goes through. The extreme diameter of this cup is at least $\frac{1}{8}$" less than the maximum diameter of the shaft, making it an absolutely tight fit.

Due to the softness of the leather seal, it works up and down or back and forth with the bearing preventing excessive wear of the seal and closing the bearing tightly at all times to leakage or entrance of dust and grit.

These leather seals have been known to run for periods of a year or more and should last considerable longer on a crane due to the slower operation encountered.

However, with the present design of the trucks we have examined, we cannot see how this leather seal which would absolutely eliminate all trouble, can be applied, and, in our opinion, the manufacturers of cranes should look into this type of construction.

The present crane trucks are constructed in such a way that there is no clearance between the cellar box and the wheel. The thrust collar rides directly against the wheel and it obviously would be too expensive to change the cranes now in existence having this type of construction.

Under present conditions where oil is continually used, if some of the above mentioned precautions are not taken, drip pans are the only way out and they in turn become a nuisance unless periodically cleaned.

In some instances oil and waste have been replaced with heavy grease which greatly aided in eliminating drippage. However, in the use of heavy grease special care and attention must be given the bearing.

In the case of cellar box type bearings, a plate is placed on the bottom of the cellar, one end of the plate resting on the bottom of the box and the other end raised by two good sized springs. The grease is placed on top of this plate and the box thoroughly filled, compressing the springs.

In operation, the springs have a tendency to push upward and keep the heavy grease in constant contact with the bottom or open side of the shaft. It has been found that if the box was kept constantly full that just sufficient of the heavy grease forced its way out to give the thrust collar of the bearing sufficient lubrication.

If attention was not given at regular intervals, while the plate and springs kept the grease up to the bearing, sufficient grease did not get out to lubricate the thrust collar, causing excessive wear.

An improvement again over the heavy grease is the use of a specially prepared long strand, heavy wool yarn grease. This type grease cannot be prepared at the mill like yarn and oil or yarn and soft greases but requires the equipment and knowledge of expert grease making.

A wool yarn grease in itself does not have sufficient springiness to insure lubrication but if used in conjunction with the plate and springs it will be found to work much more satisfactorily due to the capillary attraction of the large yarn strands and there is less danger of improper thrust collar lubrication.

Going on to the drive shaft bearings which are plain sleeve type, excessive drippage could be eliminated by changing the design of the cap which would not be a very expensive job.

Instead of a solid cap, an open type cap should be used. By this we mean the top of the cap is open and with sides raised like a box. By the use of a cap of this type proper lubrication with practically no leakage can be had by first taking a piece of burlap and laying it on the bearing surface and on top of this applying a fairly thick layer of soft grease similar to that used in pressure systems on roll necks.

The burlap is lapped over the top of the grease and a cover applied. The burlap acts a good deal like yarn, absorbing the oil from the grease and the bearing rotating against the oiled burlap is lubricated perfectly.

In this way lubricant is applied only when the

shaft is running or turning and there is never an excess applied at one time to cause leakage.

Summing up these bearings a further aid to prevent drippage would be to enclose the outer side of the bearing with a light sheet iron cap bolted on over a gasket with ordinary machine bolts or screws. This would relieve drippage from one side of the bearing entirely.

Again we say proper design would eliminate all this which we are now trying to overcome and with some fair degree of success, with lubrication.

In line with better design comes the anti-friction bearing which can be properly sealed and lubricated but of course this does not take care of the old cranes now in operation.

Some drippage is also experienced from motor bearings on cranes. On existing cranes where oil is used, a special gauge can be easily made to fit into the overflow. A piece of pipe about six inches long with a cap screwed on one end should be used. Into the center of this cap a small hole should be drilled, through which a wire is inserted. A cork float is attached to the other end of the wire and then the assembly screwed into the overflow fitting.

The bearing is filled as usual and as the oil comes up into the overflow the float rises showing the operator how much oil there is in the bearing. He does not wait until the oil runs out of the overflow and drips all over the works before finding out whether he has applied sufficient lubricant.

We might add here that liquid grease is more desirable for oil type bearings than a straight mineral oil due to the fact that liquid greases do not have the capillary attraction or tendency to creep therefore further eliminating drippage and especially important to the life of the motor, preventing creeping into the windings and causing trouble there.

In the case of grease lubricated motor bearings about the only preventative is a careful oiler, the use of good quality grease that will not bleed oil under centrifugal force or pressure and in some cases where convenient a drip pan placed under the bearing to catch the grease naturally squeezed out.

These same thoughts apply to drum and other bearings on the cranes.

Open gears on cranes should be lubricated with a heavy asphalt gear dressing which due to its adhesiveness will not run or drip off and gives good weather protection and lubrication due to the more or less slow movement of these gears.

In the case of enclosed reduction or worm gears, an extreme pressure type light bodied lubricant should be used. Usually these gears are well cased and do not give cause for worry due to leakage.

Giving further thought to good lubrication care must be taken in selecting oils of the proper body and cold test and greases of the proper consistency and melting point. The proper type depends entirely on the size, location, operating conditions of equipment to be lubricated and should be left to a competent lubrication engineer.

In summing up let us say that proper, clean, crane lubrication depends upon four major things—proper design, re-design where necessary to good lubrication—proper attention and supervision—proper lubricant plus proper application.

▲

By H. E. REYNOLDS
District Manager,
Whiting Corporation, Pittsburgh, Pa.

Leakage of oil and grease from electric overhead traveling cranes is becoming a more important matter each year and is receiving more attention. Where a crane has been provided with ample lubrication facilities it has been very difficult to prevent a small amount of oil and grease from working out of the gears and bearings and dropping on whatever may be below. In a good many installations this is not considered a serious matter, but in others, it is serious and sometimes quite costly on account of spoilage of materials.

In the handling of tin plate for instance, the drippage of oil is very detrimental. The same remarks apply to cut stone yards, printing plants, lumber mills, box factories, warehouses, and many other points in our modern industrial set-up.

A great deal of attention to oil leakage has been given by the Public Service and Municipal Engineers in connection with their power house cranes. They have been very particular to guard against any damage from drippage to the floors and walls of the power houses, which frequently are very beautifully finished on the inside with tile and enamel brick.

For cranes used in these various classes of service, it has been customary to hang oil drip pans under certain parts. This practice gives some protection but makes an unsightly appearance and is not entirely satisfactory as the pans get knocked off or tipped and then there results a real oil spillage.

The crane trolley has been the part which has given the most trouble because it travels back and forth and covers the whole floor area. With the aid of welding we have been able to develop a design which is practically leak-proof. A cast or welded steel frame carries all of the bearings of the hoist unit, so as to assure accurate alignment. This includes all of the roller bearings, herringbone gears, mechanical brake, when used, one drum bearing as well as the drum gear. This frame is mounted inside of a plate steel box which is welded to the main trolley structure. Since the only function of the box is to prevent oil leakage, no other considerations influence the design. Also by welding it to the trolley structure, there are no joints to loosen and leak. A welded sheet steel cover fits over the box with an interleaved joint.

As to the bridge drive we have developed a design which places all of the bridge drive gears near the center of the span where it is possible to enclose them in an oil tight case. This removes the bridge drive gear reduction usually placed at the end truck, where it has been impossible to completely enclose the gears with the unpreventable result of drippage.

On the other parts of the crane, when roller bearings with grease lubrication are used, there is little trouble from leakage. However with bronze bearings and an oil bath, it is not so easy to overcome leakage by a general change in design. Around the wheel axle this can usually be taken care of by providing drip pockets cast or welded to the bearing housing. In some cases separate drip pans may have to be provided to avoid unreasonable expense.

The three major changes in crane design during the past several years which probably have been the most helpful in eliminating oil and grease drippage

and resulting losses from spoilage of material, are the use of welding, use of enclosed roller bearings, and the removal of the second bridge drive reduction gear from the bridge end truck to a point near the center of the span, where it can be enclosed in an oil tight case with the first gear reduction.

By R. G. SCHENCK
▲ Sales Engineer, Fiske Brothers Refining Co., Pittsburgh, Pa.

Many lubricating devices are available for use on overhead cranes but their success in the elimination of oil or grease drippage is dependent upon the judgment of the crane operator or the attendant that takes care of the lubrication.

Let us first consider the M. C. B. type of track wheel journals. We have two plants that are having very good success using wool yarn elastic lubricant. No drippage occurs when properly applied. Enough wool yarn elastic should be put in the box to allow it to contact with the lower half of the shaft. It should not be packed in tightly (as was the custom with wool waste and oil) as this spoils the elasticity of the material and often causes drippage. It should be shifted around in the box about once each week and replenisher lubricant added when necessary.

We have two other plants using hair car grease in M. C. B. journals. This is packed in the boxes firmly so that it contacts about two thirds of the exposed shaft area. It is necessary to push up the grease about once each week.

On the cross shafts and line shafts equipped with sleeve type bearings we have found the gravity type of grease cup has not only been the most satisfactory from a drippage standpoint but it has also been the most economical. These cups can be applied only where the cup can be placed in a vertical position or at an angle of not over forty-five degrees with the vertical.

On wire cables we use a rope dressing that has a penetrating property which makes it very satisfactory for pickling room cranes. In one plant it is their practice to paint the cables on Saturdays after the crane is out of service for the week end and by Monday the rope dressing has penetrated the strands of the rope so that there is none showing on the outside of the cable and no drippage occurs.

On motor bearings of the oil ring, oil cellar type we have several installations using a lubricant of proper consistency for ring oil bearing lubrication having non-creeping properties. No drippage is had with this lubricant if the attendant keeps the oil level correct.

Anti-friction bearings are very satisfactory from a drippage standpoint but again the use of good common sense in the matter of lubrication is necessary. Excessive lubricant in a bearing of this type not only causes drippage but results in excessive heating of the bearing increasing the friction load and often times results in the separation of the lubricant itself.

Lubricating devices of all types from the simple to the very elaborate system can be installed, but drippage can not be eliminated without the use of proper judgment on the part of the individual applying the lubricant.

By E. S. GLAUCH
▲ Mechanical Engineer, Joseph Dixon Crucible Co., Jersey City, N. J.

The writer's own personal experience with spoilage of material due to grease and oil drippage from overhead cranes is somewhat limited inasmuch as the steel plant of which he was Plant Engineer, before entering the Lubrication business did not roll finished sheets or strip where this particular spoilage is greatest.

Even though there was no material spoilage, steps were taken to prevent dripping from overhead cranes. This work was started just at the time the writer left the steel mill to enter the lubrication field.

In connection with the older types of cranes, where many of the gears were exposed and a very heavy duty gear lubricant was used, it was only natural that some of the gear grease or compound would throw off.

In many cases, this trouble can be remedied by the installation of gear guards which can be made oil tight by welding the seams and it would certainly be also an added advantage in having gear cases of this type in that a better and more fluid gear lubricant can be used than would be the case if the gears are exposed. On a great many of the older types of cranes, provision for lubrication of bearings consisted mainly of providing an oil hole or oil cups. Due to the inaccessibility of these points, lubrication was accomplished by means of a long spout oil can and often as much oil would be spilled over the outside of the bearing as what was actually received into the bearing.

If the writer had this problem to contend with in a mill, he would endeavor to take steps to eliminate this feature by the installation of either high pressure fittings or compression grease cups.

Of course, we all know if a lubrication system could be installed it would be even better, however, due to the cost of installing these lubrication systems one might have to resort to high pressure fittings or grease cups.

Through the use of these fittings and the proper type of grease, I am quite sure that considerable drippage and leakage can be eliminated.

In connection with the bearings of the M. C. B. type, bearings which are, in many cases, lubricated with waste and oil, leakage and drippage in these cases can also be reduced by substituting a grease for oil, making provisions for keeping the grease against the bearing similar to that described by Mr. T. J. Flaherty in his paper which was read before this Society at the Annual Meeting in Cleveland in June, 1931.

I believe if the Mechanical and Electrical Departments together with the Lubrication Engineer of the various plants will work together providing proper gear guards and also fittings for the use of grease on bearings, wherever grease can be used, that certainly a great improvement can be shown in overcoming troubles due to this problem.

There was a paper presented before the A. S. M. E. several years ago on this subject of crane lubrication and the writer of that paper at that time felt that he preferred compression grease cups in preference to high pressure fittings, however, this feature would have to be determined in the individual plant as to whether they desired to use the high pressure

type of fittings or grease cups or even if they felt the expenditure would warrant a lubrication system whereby all bearings on the crane would be taken care of by probably two systems—one for all bearings on the trolley and one system for all bearings on the crane itself.

In addition to savings in material if oil leakage is eliminated there will be further savings in form of lower lubrication and maintenance costs.

On the present designs of cranes now manufactured, the writer does not believe this leakage is or will be a serious problem due to use of anti-friction bearings which can be fully enclosed also that provisions are made to enclose the gears.

By H. W. BALL
Asst. Chief Engr., The Morgan Engineering Co., Alliance, Ohio.

Crane design, like all other branches of applied science, is undergoing a process of continuous development which depends largely upon co-operation between the inspection and maintenance division of the crane purchasers and the engineering or designing department of the crane manufacturers.

Either of these can do much toward the realization of that very desirable condition of freedom from dropping grease, but to secure really satisfactory results, the greatest degree of co-operation between the designer on the one hand and the maintenance man on the other, will be necessary.

Spoilage of material due to grease and oil dripping from electric overhead traveling cranes and runways, has been given much consideration by the crane builders for the last several years, and more especially since the production of highly finished sheets has so greatly increased, as you all know, that the drippings of either oil or grease on these sheets is very detrimental to the sheets, rolls and pickling vats.

A number of years ago the speaker was asked to visit a soaking pit building and look over some pit cranes, and during my inspection of these cranes, the cleanliness of both the runways and girders was very noticeable. I commented on this, and was shown that they had added little galvanized sheet metal cups, located on the ends of the bearing boxes to catch the drippings. These cranes of course were equipped with the old plain bronze bushed bearings.

The development of anti-friction bearings, together with the progress made by grease and oil companies in producing lubricants that are practically non-flowing within wide temperature limits, have done much toward eliminating dripping of lubricants from cranes.

Cranes equipped with the ordinary bronze bushed bearings, must have provision for catching excessive drippage, as no adequate means can be provided to feed the bearing just the amount of lubricant that it will wear out in its running. The correct way of lubricating this type of bearing should be with a system that will automatically take care of this bearing while it is operating, and the feed be so arranged that it will cut off when it is not operating.

In connection with cranes equipped with the bronze bushed bearings, MCB boxes are used on both the trolley and bridge track wheel bearings, and these boxes are provided with reservoirs located directly under the axle for holding waste, and another method that we have been using for several years on some of our cranes has been the use of sponges instead of the waste, which everyone knows are more resilient and maintain contact with the shaft much better than the waste, and these sponges can be periodically removed and washed with gasoline and made ready for continued service.

The anti-friction bearings for crane service, a very exhaustive study of which was published in the June 1930 and June 1931 copies of the Iron and Steel Engineer, which was compiled by the Association of Iron and Steel Electrical Engineers Special Bearing Committee, under the direction of Mr. F. D. Egan, have done much toward minimizing the spoilage from dripping cranes.

Gear cases may be made oil tight by providing felt bushings surrounding a turned and polished hub. This feature, in addition to an oil tight construction of the welded case, absolutely reduces all drippings from the gears.

Where absolute protection must be provided against dripping of oil or grease, a special pan is hung underneath the trolley and so dimensioned as to catch any drippings that might occur.

As an absolute prevention from any dripping from bridge line shaft bearings, the footwalks should be extended solid to the webs of the girders and provided with suitable toe guards at their outer edges.

On cranes equipped with worm drives, we have closures which absolutely prevent any drippings from these units.

While the one-shot lubrication systems have not yet won unanimous approval by crane users, it is our belief that these systems if properly applied and operated, have done more toward the proper lubrication and prevention of drippings from the crane bearings than any other method of lubrication.

This subject has been of vital interest to us for a great many years, and we appreciate being asked to add our few words to this discussion.

By T. SEDDINGER
Engineer, National Carbon Company, Inc., Cleveland, Ohio.

The subject of "Lubrication of Overhead Cranes" is being given considerable consideration. It has been thoroughly covered by preceding speakers. The evils of drippage have been brought out, design has had its attention, and appliance of lubricants has been discussed.

My remarks pertain to the old type of cranes where the problem reduces itself to two factors, namely, retaining the lubricant, and the use of lubricants capable of withstanding the conditions now encountered.

In this connection I wish to point out that graphited greases have advantages over non-graphited greases in preventing, to a certain extent, the drippage complained of because electric furnace graphite, although a solid, is so soft that it offers little resistance to crushing between opposing surfaces, and is forced into the pores of metal no matter how small. Thus, a graphite film or surface is presented which is not only capable of resisting heat, water, and heavy pressures, but also prevents the irregularities of the metal surfaces from coming into contact with one another and breaking off. In addition, this graphite surface is more easily wetted by oil than the

metal itself due to the fact that it has an affinity for oil.

Let me illustrate: If you were to take a piece of thin, clean steel about the size of a match box, cover one-half of it with paper, and then rub graphite on the exposed surface, a sharply defined line would be made where the graphite surface begins. Now carefully place a drop of oil on this line, and at least three-fourths of the oil is attracted to the graphited area. In other words, once a graphited surface is formed on the metal, there should be less grease renewal than if a non-graphited grease is used, because the graphited surface will require less additional grease (owing to the oil contained) than will plain metal on which the graphite surface has not been developed. And it follows that the less grease used, the lesser the tendency towards drippage.

However, while graphite can play an important part in reducing the amount of grease to be used, its effect depends on using the proper vehicle to conduct it to the metal surfaces.

One grease company is in the midst of a series of tests in several steel mills which bear a relation to the subject under discussion. Electric Furnace Graphite with an unusual carrier is being used on overhead crane bearings. Results show less frequent and smaller grease additions due to the action of the graphite on the metal, and also the wetting of the graphited surfaces by the oil of the added grease.

By PHILIP KING
Engineer, Keystone Lubricating Co., Pittsburgh, Pa.

Good housekeeping may not in itself produce a quality product, but I do believe that good housekeeping to a great extent adds to the quality of a product. Give a worker clean material, clean equipment and a clean, well lighted shop and a quality product should be the result.

I believe that this same statement applies to any manufacturing plant whether this plant produces iron, steel or alloy sheets and plates, or silk shirts. Of course, my remarks are built around the steel plant overhead traveling cranes, their lubrication and cleanliness that results from proper lubrication.

A few years ago very few of us gave any considerable thought to the ultimate damage caused to a high finished sheet or plate when subjected to a drop or two of oil or grease. If this particular sheet or plate did not pass inspection, well, that was just another reject. Today we have an entirely different condition, not only from the manufacturers viewpoint but also from the viewpoint of the consumer. The consumer will not absorb the loss of many unfit units caused from some defect occurring in the steel plant.

I do not intend to state here that all defects that sheets and plates are subject to are caused by drippage of oil or grease. Neither do I say that all oil or grease spots found on sheets and plates are caused by drippage from overhead cranes. Such a statement would be unjust to the men that are responsible for the maintenance of the overhead traveling cranes. Much of it may be laid to improper oiling and greasing of roll necks, conveyor chains and tables. It may be the application, or it may be the lubricant.

However, we have made considerable progress in developing grease and oil lubricants designed particularly for crane and cable lubrication, that when properly applied and maintained, very little or no drippage will occur from overhead cranes.

Cranes equipped with roller bearings may have some advantage over cranes equipped with split sleeve bearings and M. C. B. trackwheel journals in the manner of requiring less lubricating attention. Even they will give trouble should the improper lubricant be used.

I have stated that there are lubricants on the market designed to lubricate the various moving parts of overhead cranes. These lubricants cannot be entirely successful unless properly applied. I mean by this that there is a method whereby application counts as well as the quality of a lubricant. We cannot expect a cable lubricant that was designed to be a non-drip to remain entirely on the cables and sheave grooves if it has been excessively applied. Neither can we expect to properly lubricate gears when gear housings are leaky. I do not think we can expect to have a leak-proof gear cover but I do believe that with the proper lubricant, and a good gear housing that little trouble would be experienced with drippage from this source.

Sleeve type split bearings are a source of grease leakage when worn or badly fitted to the bearing housings. Much of this can be eliminated by splitting the bushing before machining. Then machine to the correct fit and dowel to prevent motion within the bearing housing, and the use of a grease cup that has some means of adjusting the flow of grease required. Such cups are on the market. Motor bearings of the oil ring type cause considerable drippage unless care is taken to prevent over oiling. Excess oil drips from the overflows due to over oiling, the motion of the crane and the rotation of the oil ring, raising the oil level from side to side, depending on the direction of rotation.

Trackwheel bearings of the M. C. B. journal type are a source of annoyance when a too fluid a lubricant is used. In many instances wool waste and black oil is used. This makes a messy condition and considerable drippage unless watched very carefully.

Some manufacturers are using a type of grease on their crane M. C. B. boxes that does not flow under a wide range of temperature changes. This grease lubricates by contact with the trackwheel shaft. Another method now being tried is to use a thin slices of grease held in contact with the shaft by a simple mechanical arrangement that can be adjusted to suit special conditions, also to insure the application of lubricant to that part of the shaft that extends beyond the oil cellar.

It is evident that considerable savings would result to the manufacturer in his lubrication costs, and the elimination of material spoilage should he avail himself of the proper lubricants and good application.

By F. C. HALLMARK
General Master Mechanic, Wheeling Steel Corporation, Steubenville, Ohio.

A few years ago the heading of this subject would not have been "Spoilage of Material" but "Untidiness of Floors". We say this because a few years ago materials were not really spoiled by dripping grease and oil—not that grease and oil didn't drip—it did,

and in much greater quantities then than now. However, inspections were much more lenient and the margin between production cost and selling price much greater, therefore, the additional costs for cleaning materials and taking the necessary precautions against drippage were not considered serious.

However, today it is very well known by all who are in any way connected with the manufacture of iron and steel that the story is entirely different. Inspections are hard, profits small and the greatest possible yields must be obtained.

Of course, paramount in the minds of operators and maintenance men is the question of how to eliminate this nuisance. The answer to this question is comparatively simple when new installations are considered. Late designers have given grease tight bearings some thought and have succeeded in the elimination of a great deal of grease drippage. This is especially true in the installations of anti-friction bearings. However, we believe the designer was influenced in the right direction more by his desire to protect the bearings than by any intent to protect material on the floor—in either case the result has been gratifying.

It must be remembered, however, that by far the greater percentage of overhead cranes in operation were designed and built before any complaints were ever made against grease and any one recommending anti-friction bearings would have been locked up for safe keeping.

These old cranes are the ones that present a real problem necessitating in a great many cases complete redesigning of truck bearings. Line shaft and trolley bearings are easier to take care of—in most cases cover plates and seal rings are satisfactory.

The next big problem in elimination of grease drippage is to educate operators to grease bearings properly. Whether they be the latest type anti-friction bearing or the old sleeve type, the general rule seems to be the same: they hook up a heavy grease gun and pump grease into the bearing until it begins to pop out around the journal or shaft due to several hundred pounds pressure inflicted with the gun. Naturally, the excess grease will work out of the bearing until the pressure on the inside becomes normal and finally finds its way to the floor.

The writer firmly believes that more drippage is caused by over greasing than by any other cause and maintenance supervisors are more to blame for this condition than the operator. In days gone by it was considered an almost unpardonable sin for an operator to lose a bearing and naturally he is going to see to it that the bearings are well stuffed with grease to eliminate as far as possible the danger of losing his job.

The most outstanding example we know of where equipment with old style sleeve bearings receives proper oiling is our trunk line locomotives. There is no harder service on bearings. Still if you take the trouble to look along main line railroads you will not find any grease drippage. The answer, of course, is the required amount of grease for these bearings has been carefully measured and the operator furnished with the exact amount to carry him over his run.

Another very important item to consider in the elimination of grease drippage is the selection of the right grease, however, there is little for the maintenance man or operator to worry about from that source. Lubricating engineers have given that phase of the subject much study and their recommendations can in most every case be relied upon.

In summing up—of the three responsible parties—the designer, the maintenance supervisor, and the lubricating engineer, we believe the greatest responsibility for the elimination of grease drippage rests with the designer and the maintenance supervisor, especially the latter in the education of operators.

By O. L. MAAG
Lubricating Engineer, Timken Roller Bearing Co., Canton, Ohio.

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With modern designs and anti-friction bearings there is very little trouble with leakage of oil and grease, but with the old style units, prevention of dripping is not quite so easy, and the maintenance man must be careful not to put too much lubricant in the bearings. However, these conditions can be helped somewhat by using oil thickened a little with soap. To eliminate it entirely you will have to redesign the bearings, or go to the use of anti-friction bearings. Almost all of our applications are now anti-friction. Here again you can over-lubricate, but with average precaution no trouble should be experienced. The lubrication of anti-friction bearings can be taken care of by using oil, maintaining a low level of lubricant sufficient to take care of the bearings but not high enough to give rise to leakage. If the designs are correct, as on our railroad applications, a correct level of oil can be maintained which will not give rise to leakage, by periodic inspection, and measuring the oil depth with a finger gauge. Another very satisfactory method, if you want to maintain a definite oil level and not be required to make periodic inspections is to use constant oil level bottles, which, as the name implies, will maintain the proper level at all times, and all that is required of the maintenance man is to see that there is oil in the oil bottle. Your trouble is usually due to over-lubrication and poor closures, and, in the case of grease lubricants, often too soft a lubricant is used. The tendency is to use softer greases than should be used as they handle better and easier with the usual grease guns used.

By using heavier consistency greases, less leakage will occur. We recommend the heavier grades, usually to decrease leakage, although the softer grades are as good if not better from the lubrication angle.

By L. F. COFFIN
General Master Mechanic, Bethlehem Steel Company, Sparrows Point, Md.

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Unfinished sheet steel in the sheet mill and untinned black plate in the tin mill are the two products which suffer most damage from this factor.

In both these mills, care is taken to wipe off all seepage of greases and oils and zerk type grease fittings are used for filling bearings. This type has a small hole and guns deliver small quantities per stroke. Millwrights are employed as oilers and are charged with keeping the drippage at a minimum.

Journals on bridges and trolleys are packed with a mixture of No. 3 cup grease, black oil and waste. This is mixed by hand in small lots to suit the con-

dition on each crane. Quantities of cup grease are varied to suit atmospheric temperature.

Gear coats are applied with brushes through flaps on gear covers.

Since changing oilers and substituting millwrights, the damages caused through inefficiency of former oilers, has been almost eliminated.

By E. C. KIRKPATRICK
Mechanical Engineer, The Steel Company of Canada, Limited, Montreal, Canada

We have had very little trouble from oil dripping from cranes and spoiling material stored beneath them. However, oil does drip from one or two of our cranes, and we have had to go to a certain amount of trouble to prevent this oil from spoiling material on the ground. In these cases the oil did not drip from any of the bearings of the crane, but came from the hoisting gear box in which the gears run. The oil crept along the shaft from the gears, and it would appear that packing boxes should be provided at this point.

All cranes that have been installed within the last few years have been equipped with anti-friction bearings and no grease has ever dripped from them.

By L. R. BEERS
Plant Engineer, General Electric Company, Schenectady, N. Y.

We have never suffered any particular loss due to leakage of oil from overhead cranes. In the first place, we have pans underneath oily parts, catching the drip which eliminates most of the hazard and in the second place, the nature of materials used in our manufacture is such that there is not any particular damage if oil is dropped. The most damage is occasionally drops of oil may fall on some one's clothing, which is not very serious.

I do feel that in some industries, such as textile, paper industries, etc., overhead cranes might cause considerable loss and spoilage due to oil.

I think at the present time, approximately 80 per cent of the industrials are using overhead shafting and I think the damage from oil is much more severe due to this cause than it is to traveling cranes.

If some members of the Association have suffered from spoilage of material due to oil, it is very possible that the installation of individual drive, with the subsequent elimination of overhead shafting, will do more to clear up their trouble than anything they could do to the crane.

By W. E. SMITH
Lubricating Engineer, National Refining Co., Cleveland, Ohio

It is not necessary to discuss means for the prevention of dripping of grease and oil from new cranes since the manufacturers have taken care of this in the design of cranes being made at the present time.

Our problem is to prevent dripping from cranes now installed and in service, in some cases for as long as twenty years. Twenty years ago mills were not making highly finished sheets and a spot or two on a sheet did not cause the material to be rejected unless it was to be galvanized or tinned. With the demand for a better finish on steel sheets and strip steel, these grease spots caused so much loss that it was necessary to find some way to prevent grease and oil from dropping from cranes.

One of the first plans was to place waste around the track wheel bearings, fastening it in place with wire or string so as to absorb the overflow of black oil or journal oil that was in general use at that time for lubricating not only the track wheels of the bridge and trolley but all the other bearings on the crane, including the armature bearings.

Drip pans were also used but neither the use of waste nor pans was a success because it was impossible to apply the waste or attach the pans so that all the dripping would be caught.

One year ago last June, at the meeting of the Association of the Iron and Steel Electrical Engineers held in Cleveland, Ohio—a method was described which made it possible to use a hard grease for the lubrication of the track wheel bearings.

The use of this device, which is a spring loaded or counter-weighted arrangement placed inside the waste pocket so as to hold the block of grease in contact with the shaft, puts the problem of supplying a satisfactory lubricant for this purpose up to the grease makers. It was soon learned that while the use of hard greases applied in the above manner stopped the dripping, it also retarded the movement of the crane—probably because of the fact that the grease did not furnish as fluid a film on the bearing as the oil that had previously been used.

With this in mind, it appears that a grease must be found having the following qualities:

A high melting point.
Hard enough so that the block of grease will retain its shape under the pressure of the spring-loaded or counter-weighted device.
No organic filler.
Made of high viscosity oil.
Ability to provide lubrication at all temperatures.

If the jack shaft and line shaft bearings have caps with openings in the top that are large enough, hard grease may be used in them. However, in most cases they are not large enough and the only remedy is to apply the oil more often and use only enough to lubricate the bearings without running off.

If the oil is carried too high in ring oil bearings, the sudden starting and stopping of the crane tends to throw the oil out of the ends of the bearing.

Cable dressing should be used with care. The tendency is to apply too much at one time. Frequent applications of small amounts of oil to bearings on old cranes in which hard grease cannot be used, should reduce the loss due to dripping, to a great extent.

By W. P. SHEEHY
Maintenance Engineer, The B. F. Goodrich Co. Akron, Ohio.

I have been wondering whether or not a statement from one engaged in the manufacture of rubber products could be of any particular use to those who are primarily interested in the care which must be exercised in the manufacture of steel.

In the first place, I would say that overhead cranes, which in the steel industry are an important

part of the production job, do not function as such in the rubber industry. With but few exceptions, cranes which are installed in plants such as ours are used primarily for maintenance work and handling of heavy machinery. Therefore our situations are not comparable.

While oil and grease are the natural enemies of rubber and extreme care must be exercised in their application and use so as not to have them come in contact with either finished or unfinished products, drippage from overhead cranes and hoists is almost negligible when compared with trouble experienced in this respect from other types of mechanical equipment.

I believe that you will see from this that we have very little to offer in the way of information which will be helpful to the people who constitute your constituency.

By W. D. HODSON,
President, The Hodson Corporation,
Chicago, Ill.

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To correct the difficulty indicated by our subject, we look forward to the day when lubrication to cranes will be applied mechanically more generally, preferably automatically in predetermined adjustable amounts at predetermined regulated periods. All devices for lubricating, including mechanical systems, provide means for adjusting the quantity, but the adjustability of the period of application is just as important, as regardless of how much the feed may be cut down at the points requiring small amounts of lubricant, the common period of application will provide more lubricant than is needed. Therefore, this will not only be wasteful, but will defeat the main purpose of eliminating the dripping on to the stock below. There has been considerable advance in mechanical automatic crane lubrication, but there is much yet to be done.

To bring about the desired improvements, we should first have the co-operation of the crane designer and manufacturers. The most casual observation demonstrates that there have been many improvements in crane design and manufacture, but there still remains much to be done. Cranes of the latest types installed within the last year in the most modern continuous strip mills, both hot and cold, have open gears to be lubricated, and no provisions are made to prevent the lubricant being thrown off or dripping on to the stock. In one of these recently installed mills, the superintendent of construction had pans mounted under the open gears to prevent the lubricant dripping on to the stock. Such devices help, and probably serve their purpose in a large measure, but "home-made" devices are generally more or less makeshift. These necessities should be provided for by the builder of the crane. If lubrication engineers and mechanical and designing engineers would earnestly co-operate, we believe that marked improvement would result therefrom with but little trouble or increased cost, if any. In any event, the cost to the crane customer would be reduced not only in the installation of his equipment, but also in maintenance and repairs, and what is more important, in protection to their product.

The trouble is not wholly because of improper crane design. Much of it, if not the greater part of it, is through lack of judgment, carelessness and neglect in the application of the lubricant. Whatever the design of the equipment is, after it is once installed it has to be lubricated as is, (unless lubricating devices of some sort are applied) and the greaser must use the lubricant which is provided. (Frequently the greaser of the crane has but little, if any, choice in the kinds of lubricants he must use, and is often required to use wholly undesirable lubricants.) With the proper attention and care, even with these unsuitable conditions and materials, much of the present trouble can be avoided.

Wire rope lubrication should be accorded better attention. The recent investigation of ladle crane lubrication, (the report of which was made in the June 1932 issue of the Iron and Steel Engineer) brought out the fact that a number of mills are using black oils, cylinder oils and some residium oils, which I do not believe would be considered desirable for the purpose by those using them, if they knew of the more suitable types of wire rope lubricants that are available. In the sheet and tin mills, and hot and cold strip mills, temperature conditions are not liable to be as severe as over the ladles, but such lubricants as referred to are apt to throw and drip off on to the stock, and we believe the discontinuation of their use would be helpful.

The selection of the proper lubricants, no matter what the conditions, is exceedingly important. While it is always desirable to make one grease or lubricant or oil fulfill as many requirements as possible, there is certain equipment, such as overhead cranes, where the lubricant most suitable for the service should be used, even though it may result in more kinds of lubricants being used than is desired. The ordinary standard types of cup greases and gear shields are not suitable, and will not provide the maximum service possible with lubricants developed especially for such purposes.

For enclosed geared units, where it is necessary to lubricate the bearings, roller and sleeve, as well as the gears with the same material, it must be adapted to that joint use. Frequently the same lubricant is used for cranes out of doors subject to all weather conditions, as well as those inside the plant, therefore they must meet the extremes of temperature changes. The open gears should be lubricated with another type of material, one that is highly adhesive, and has spreading and film building qualities.

The truck journal bearings, particularly on the old type of cranes, are a severe problem. In some mills it is the practice to use cylinder stocks, and black oils with wool waste. These oils are very susceptible to temperature changes, and in most cases it is necessary to repack the bearings weekly. There are lubricants available which have been in use for five years now in a number of large crane installations for wool waste packed journal bearings, where it is only necessary to replace the lubricant every three or four months, instead of weekly as previously. In the use of this grease, it is necessary to cut the wool waste to the proper lengths instead of using it in hanks as heretofore, which with this type of grease would cause the wool waste to wrap around the journal.

For the other bearings, a good type of lime base grease, which is resistant to a wide range of temperature changes, should be employed. Vibration of

cranes sometimes leads to the soap and oil of a lime base grease becoming separated, therefore improper lubrication results. Where this happens it would be advantageous to use the new types of anhydrous lime base greases which will not separate by vibration. These suggestions are based on three year's experience in one mill where these products are serving over 100 cranes, indoors and outdoors. Another a sheet mill has been using these materials for five years on some 20 cranes operating indoors and outdoors. The following is a condensed statement of the master mechanic, as to the use of one of these materials on waste packed journal bearings:

"1. We have been using this material for five years.

2. We use two densities, one for the Summer months, and one for the Winter months.

3. It has reduced the cost of our lubrication.

4. Drippage has been completely eliminated. Even signs of lubricant on the girders has disappeared. There has not been one complaint from drippage since using this material.

5. Not one cut bearing.

This material is used by saturating the wool waste, which is not changed oftener than three to four months. If during that time the waste gets too dry, we add more lubricant. During the Winter months, because of the slightly adhesive qualities of this material, it is necessary to loosen up the waste before starting up after a shut down."

In preparing to take our part in this discussion, we asked for data from mechanical departments who have had experience along the lines indicated. Among the communications received was one from Mr. E. B. Talkes, the Superintendent of Construction of the Inland Steel Co. at Indiana Harbor, Ind., who states:

"Considering the dripping of oil and grease from overhead cranes, I list in the following the chief points in the order of their importance.

1. The crane should be in good mechanical condition. Where lineshaft bearings, trolleys and jackshaft bearings are badly worn, it is not reasonable to expect oil or grease to stay put. A large proportion of the lubricant is wasted and is spattered over the crane and on the floor or stock.

2. Much of the difficulty is eliminated by doing away with the old style hand grease cups, and replacing them with pressure gun fittings.

3. All gear casings should be made oil tight wherever possible.

4. The track wheel bearings should be provided with a drip pan filled with wool waste to absorb the dripping oil. Our experience has found this plan very satisfactory, with the renewals of the waste about every three months.

5. We find that our cranes which are equipped with automatic lubrication, whereby the crane operator by a stroke or two of the lever discharges a predetermined amount of lubrication to a number of bearings, gives by far the best results, as when used with judgment there is no waste or surplus of lubricant delivered to the bearings to drip off to the stock. We have one installation where the lubrication is automatic, being operated by the crane control during the hoisting period only. This is the cleanest crane in our plant.

6. On cranes where hand lubricating is still used, we have done away with the old style grease cup and the antiquated long spout oil can and grease bucket. In place of these we are using pressure gun fittings and a portable pressure gun holding about 20 pounds of grease.

7. Of prime importance is the selection of the proper lubricant. Even if none of the afore mentioned devices are used, conditions can be greatly improved by the careful selection of the lubricant and its intelligent use.

8. We have found a special lubricant developed particularly for wool waste packed journal bearings, which is ideal for this purpose. We are careful to use wool yarn waste cut in short lengths and set vertically in oil boxes to give it the capillary attraction to the journal.

9. A special gear lubricant, which we use largely for both open and enclosed gears throughout our plant, we have found particularly useful for the exposed gears. Its high lubricating qualities and adhesiveness makes it necessary to apply but small amounts which eliminates dripping."

In conclusion I wish to emphasize the following:

1. Greater consideration on the part of the crane designer and builder in providing means for properly applying lubricants.

2. An earnest co-operation on the part of lubricant engineers and manufacturers in making known their requirements to the crane engineer and builder.

3. More intelligent selection and use of the lubricants for the older type of cranes.

4. The desirability of more attention to mechanical lubricating devices.

5. The use of lubricants developed especially for the demand of crane lubrication.

By J. A. VOSS
Safety Director, Republic Steel Corporation, Youngstown, Ohio.

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The elimination of oil dripping from overhead cranes has been given considerable consideration for the past several years from the standpoint of spoilage of material as well as the safety feature. The best method is to use anti-friction bearings throughout all moving parts of cranes, however, due to the fact that many old type cranes still require oil, it has become necessary in many instances to provide shallow pans and suspend same underneath motors to catch the drippings. The use of special grease in place of black oil, and wool waste in journal boxes have been of great assistance in eliminating the trouble caused by oil drippings.

Oil dripping on crane runway girders makes them very slippery and a pronounced hazard to anyone required to walk girders. In order to reduce this hazard to a minimum, we have in many instances placed pieces of burlap on end truck and on trolley trucks so as to mop up oil. In some instances we have placed railings alongside of crane runways which afford a handhold when necessary to walk crane girders. These railings are also used to attach safety belts when changing truck wheels or doing any work on the runway where there is danger of men slipping and falling.

While the safety feature enters into the many conditions caused by oil drippings from overhead cranes, nevertheless, I believe the spoilage of mate-

rial is more pronounced, therefore, suggest that this subject be discussed by an electrical engineer rather than a safety engineer.

Discussion

R. W. Schuette: I have little to add to this discussion. I think a great many of the problems have been discussed by Mr. Hallmark. In new installations the problem should be taken care of by the new design. In old installations each bearing has a problem of its own and must be worked out to suit that particular case.

C. J. Klein: We believe there is little doubt in anyone's mind but that the operators have a great deal to do with the prevention of grease and oil drippage from cranes; in other words, it is logical for the greaser to apply lubricant until some evidence of sufficient lubrication, which usually results in an over-supply of oil or grease, thereby causing drippage. In most places where drippage from cranes is evident, it is not necessary to protect material under processing, in other words, it will be noticed mainly around the open hearth scrap yard, open hearth buildings, soaking pits, blooming mill buildings, bloom and slab yards, scrap yards, etc. In going into the finishing departments, drippage from lubricants is not seen. Some special precautions have been taken in order to accomplish this result, in that wipers, overflow pockets, drip-pans, etc., are provided to eliminate drippage at these points. It is absolutely necessary to go to this extra expense and trouble to maintain these conditions where oil would affect the finished product. Steps have been taken with the design and operation of modern cranes to eliminate costly waste of lubricants as well as the unsightly conditions caused thereby, and we believe it to be a matter of a few years until this has been eliminated entirely.

J. I. Kaspari: We have done a little bit of experimenting in a very small way towards elimination of oil drippage, in a department where oil drippage would not make any difference. We take out oil waste and use hard grease held up against the journal with a paddle. It seems the grease we are trying has a very long life, doesn't get hot and run and the bearings have lasted as long or longer than when using grease or oil with waste. As far as finishing departments are concerned, we don't use any lubricant on crane cables. In other departments the cables are lubricated. On all bearings for finishing departments we have drip pans underneath the bearings to catch excess oil liable to drip out. These have to be taken care of periodically. Another thing that helps on bridge girders is a piece of rag or gunny sack tied on the trolley and the bridge girder is wiped before the oil has a chance to get down on the floor. This wiper has to be removed every so often and a new one put on.

W. Dudley: I have been very much interested in what has been said on the subject of spoilage resulting from drippage of lubricant from overhead cranes and have learned a number of things this afternoon. Many practical suggestions have been made to overcome what has generally been looked upon in the past as a necessary evil but I believe by concentrating on the problem it can be solved for old cranes as well as those of a later design. In fact judging from statements made by various speakers the trouble has been overcome in numerous specific instances.

It has not been so long ago that oil leakage from motor bearings was considered a necessary evil but that condition has practically disappeared in steel mill motors and careful attention to crane bearings will work the same degree of improvement in them. It is evident that the importance of the problem will vary somewhat with the character of the material being handled as well as with the position and activities of the workmen on the floor. Where the finished work is actually spoiled by crane lubricants as is usually the case with many grades of highly finished sheets some positive means of preventing drippage is necessary. This same requirement will hold where numerous skilled workers on the floor are exposed to discomfort and annoyance from this source.

In scrap yard, open hearth, stripper building, soaking pit, blooming mill and other similar locations the actual damage from drippage of lubricant is negligible but in many cases it is very undesirable. While a condition of this kind would hardly justify the expense of absolute prevention of leakage the dictates of good maintenance will justify a study of the problem and in many cases it will be found that relatively inexpensive changes or devices will make a vast improvement. If it did nothing more than prevent grease from collecting on the rail girders and thereby decrease the hazard for those workmen whose duties sometimes force them to use the girders for a walkway the expense and trouble would be justified.

J. B. Sullivan: Excess grease and oil around cranes and runways that accumulates from overgreasing or oiling, may be blamed on the crane inspector or oiler for not cleaning it up after the greasing is done, but not for being there in the first place for in most cases the only sure way the man has of knowing whether or not the bearing has sufficient grease is to keep pumping it in until the old grease comes out. Then we all know the bearing has had too much grease and as soon as the bearing is run, it will heat up and the excess grease will come out. The blame then may be put on the oiler for not going back and wiping it up; but to start with why don't the manufacturers of cranes and roller bearings develop a bearing housing that will indicate to the greaser or anybody at all times just how much grease is in the bearing without taking off the end cap or cover and going to a lot of excess work.

O. L. Maag: If you have separation, it is mostly due to imperfect compounding of the grease. A properly compounded grease should not separate with normal usage. Soda soap grease of short fibre would likely be an improvement for your application.

J. B. Sullivan: Suppose you use a light grease which has a small amount of soap to separate under high pressure or heavy oil even petroleum of any kind it takes for the job, you should know approximately how much is in the bearing at all times.

O. L. Maag: A condition like that is taken care of if you put in a little heavy oil to hold the level of your oil.

F. C. Hallmark: There is one point that is not clear to me. If some bearing man in the meeting

will explain a little more in detail maybe I will understand it. It has been brought out in several papers and we all know it is wrong to pump a bearing so full of grease that it blobs out at the end of the axle; now on anti-friction bearings how does the man know when to stop pumping grease?

M. Reswick: The chief engineer of a company in Cleveland, which specializes in building electric motors informed me that nearly ninety per cent of all complaints they had on bearings was due to lubrication and that a majority of those cases were attributable to putting too much grease in the bearings. They decided to put in a plug about half-way up from the bottom of the bearing to serve as an overflow for any excess of grease that may have been injected into the bearing and as soon as they started this practice their complaints on bearings and lubrication have dropped down to 5 per cent of their previous experience.

N. C. Goin: If a spring loaded ball check fitting be installed so that a lower pressure can be used than is necessary to force grease through the glands it will prevent this trouble. Of course, it will be necessary to find a satisfactory location for this fitting.

J. L. Young: This problem was discussed this afternoon quite thoroughly.

It is well to provide some sort of a vent plug, generally a pipe plug, drilled two ways, and screwed into the upper opening with the opening of the plug down. The lubricant is generally forced in at the bottom and any excess lubricant that might be forced in will find its way out through this vent plug. The bearing will automatically get rid of any excess lubricant by building up an internal pressure sufficient to force the excess grease out through the vent plug, especially if a good tight seal, such as the leather packing or the metallic packing is used.

This vent plug used in connection with roll necks forms a ready tell-tale at the time the operator is forcing the lubricant into the bearing housing for at that time the bearing is rotating. In connection with cranes, the bearing is generally stationary at the time of lubrication and for that reason it will be necessary for the operator to become experienced in the art of finding the point of stoppage in order to prevent an excess amount of spillage through the vent plug after the bearing starts to revolve. Experience will naturally teach this knowledge of the proper amount of lubricant to add. So far, this method of lubrication has been very successful on cranes as well as on rolling mills.

There is one thing that came up this afternoon about metallic packing that was not made clear and several questions have been asked since the afternoon meeting in regard to the use of the metallic packing and the clock spring in connection with oil or grease. It is our experience that this metallic packing is entirely satisfactory for grease lubrication but the only place where we have tried it in connection with oil lubrication has been a failure. We have had absolutely no trouble with it in connection with grease lubrication, but for crane work, let me again state that the leather packing seems to be the best and most economical for the class of work.

J. B. Mitchell: "In order to eliminate the trouble of oil or grease dropping from overhead cranes in the 14" Merchant Mill, we have endeavored to teach our operators to exercise more care in the application of lubricant. We find that next to the installation of an expensive grease system this more nearly solves our problem than any other method we have tried".

R. G. Schenck: The only comment I would like to make on ball bearing motor lubrication is that by taking off the pressure fitting and putting a pipe plug in, the man who is doing the lubricating is not so apt to give it a shot of grease too often, if he has to remove a pipe plug to apply the lubricant.

J. I. Kaspari: We thought that on roller bearings in motors, by the time grease got low in the bearing it would not be a bad idea to inspect the bearing, and at the time it was opened for inspection you can see how much grease you are putting into it. We have a schedule of about six months for inspecting bearings. Each bearing goes about six months before it is inspected and regreased again.

S. A. Newman: Bearings should be inspected periodically, as any oil or grease will eventually oxidize. Many times we are called on complaints where the trouble is caused by the oil in the grease oxidizing. A lubricant oxidizes rapidly when high temperatures and high speeds are encountered. We recommend periodic inspections to determine how long a lubricant should stay in service in an anti-friction bearing.

L. M. Wampler: Various applications require different periods for lubrication. We laid out a schedule of every three months for inspecting and lubricating bearings and we had several bearing failures due to lack of sufficient lubricant.

On soaking pit cranes where there is high external heat and excessive temperature within motors due to short moves of crane, we have found that bearings must be lubricated once a month. So I do not see how you could lay out a definite period for all to follow.

S. A. Newman: I agree with Mr. Wampler. We have known some bearings that will run five years without renewing the lubricant, while others may need attention at much shorter intervals.

J. W. Bates: How is that particular lubrication schedule arrived at? Many of us have achieved what we consider a satisfactory lubrication schedule, only to find that with reduced operations too much grease was being applied.

J. I. Kaspari: I did not mean to convey the impression that all bearings go six months before inspecting. We started within a month and gradually that time was increased until now we inspect every six months. Some bearings are different and have to be looked at more frequently than every six months. In soaking pits so far as motors are concerned, greases will stand as much temperature as the winding in the motor.

J. S. Kenney: We have 24 A.C. Motors that operate in a very dusty place and it has been our practice to take these motors apart for cleaning every six months. Our practice has been to grease the roller or ball bearing motors once every month. On taking these 24 motors apart we found very little grease in the bearings. Now if we had some way of telling how much grease is in the bearing, we could

hold someone responsible if we lost a bearing on account of not being greased properly. As it is now, some manufacturers say to grease roller or ball bearings every 6 months, others say once every year. The scheme of using a vent hole in the top of roll neck bearings where the grease will come out when the bearing has sufficient amount of grease should work the same on motor bearings.

F. C. Hallmark: The length of time a bearing should run without being regreased must be determined by the operating man. I do not believe any manufacturer could say his bearing should be re-oiled every six months, a year or two years, because he does not know the conditions it is operated under. The man who operates it should determine that the himself. We should allow a minimum of time to inspect the bearing, the next time a little more. We can usually judge by the condition of the bearing as to how much longer it should have run before it was opened up.

There is one thing I would like to ask in connection with roll necks: Mr. Young thought an overflow plug should be installed in a bearing of this kind. As everyone knows during the past two years, due to operating conditions, we have had to change rolls quite often. The more often you change rolls the more often you change grease. We have changed more rolls in hot strip mills where Timken bearings are used than we have in cold strip mills where Messinger bearings are used. Naturally, the grease in the Timkens is changed oftener. Should the elevation of overflow be the same for the Messinger bearing as recommended by Mr. Young for Timkens?

R. W. Schuette: The vent hole near the top of a bearing allows the trapped air to escape from a tightly sealed bearing and also acts as an overflow for excess lubricant if the vent hole is not too small and the lubricant is not too thick.

I have seen roll neck bearings with two holes near the bottom, one on each side of the centre. One hole is connected to a pressure lubricator, the other closed with a pipe plug.

With the pipe plug removed and the bearing rotating, the lubricant is forced into the bearing until it flows out of the open hole. When the flow ceases the pipe plug is inserted.

I know of no device to tell how much lubricant is in a bearing after it has been in operation for some time.

A very good method is to use an automatic pressure lubricator wherein the quantity of lubricant and time interval of application are adjusted to suit the needs of a particular bearing.

In the case of two like bearings working side by side one bearing may require more or less lubricant than the other.

Regardless of kind of bearing each case is an individual problem to be worked out for satisfactory operation.

J. L. Young: That is correct. The reason that it works on the low level as well as on the high level is that a certain amount of pressure is built up in the bearing housing and the excess grease is forced out but if heat should occur or if separation should occur in the grease with the vent plug at the lower level, it will have a tendency to drain the oil from the grease and gradually separate that oil from the soap content of the grease, with the result that the residue will be left in the bearing chamber. If the vent plug is placed near the top of the chock this cannot occur.

J. B. Sullivan: Inspecting roller bearings once a month or whenever the operator deems it necessary may have some advantages or may not. You can picture the excess cost connected with this operation when you have about 8000 roller bearings in the plant.

J. L. Young: Some people use gasoline or kerosene to do the same thing and rotate the bearing in that mixture so that it will take the foreign material into solution and then be drained out when the drain plug is removed. The use of a high viscosity thin oil that can be heated to a high temperature and fed in to the bearing during rotation and then wiped out or drained out while it is still warm and while the bearing is still operating seems to be the best possible method of flushing a bearing.

R. R. Owen: What are the objections to using oil instead of grease in an anti-friction bearing?

J. L. Young: Oil lubrication is always better than grease lubrication from the standpoint of bearing operation, but there are some places where it is either difficult or impossible or impracticable to use oil. On roll necks the reason for the use of grease is apparent because of the changing of the bearings from one roll neck to another daily or in some cases, even more often. If oil were used, the chock would have to be drained at each change and would have to be properly lubricated before placing the bearings back in operation. There are also other complications such as the necessity for a circulating oil system in some cases, and the expense that goes along with such a system. Whether oil or grease lubrication is used is purely dependent upon the application involved.

M. Reswick: I would like to tell you about a plan in one of the steel plants in connection with filling roller bearings with grease. They change bearings once a week and use grease right out of the drum by means of a hand pump. The drum is placed on a scale and the scale adjusted so when a pre-determined amount of grease is pumped out of the drum the scale indicates it and in that manner they are always sure that the proper amount of grease is put into the bearings at the proper time.

F. C. Hallmark: If the mill is normally operated four days and due to conditions actually operated only two days, it will probably take only half the grease.

M. Reswick: It would have to be figured out on a work-day basis instead of calendar basis.

F. C. Hallmark: I think an overflow method of this type is the best. Keep a record on each bearing as some need filling oftener than others. One bearing might be using twice as much grease and do the same amount of work.

O. L. Maag: In regard to flushing out bearings with gasoline or kerosene, we would much rather see a heavy oil used, as the heavy oil will tend to carry out any foreign matter in the housings. With kerosene or gasoline, there is a tendency for heavy foreign matter to settle and stay in the bearing housing, and then when new heavy lubricant is added it will soon find its way back into the bearings.

J. L. Young: In connection with the use of gasoline or kerosene, there is a hazard of a possible, and maybe probable, explosion within the bearing chamber that makes it further undesirable.

J. A. Burg: There have been a considerable number of very interesting papers read and they seem to have covered the question of eliminating the oil dripping off of crane runways and cranes quite thoroughly.

The new cranes, properly designed and equipped with anti-friction bearings have practically eliminated the oil drippage. However, we all have many cranes of older designs on which we do not feel justified to spend a lot of money to redesign. In my opinion, it is practically up to the maintenance men to eliminate this trouble on their old equipment by proper training and supervision of the men responsible for the oiling of the cranes.

H. S. Griffith: While the crane manufacturers have taken care of oil and grease leakage on new cranes, they have also made improvements that could be applied to older cranes to prevent this trouble. I believe that if the gentleman will get in touch with the manufacturer of his cranes, he will receive helpful information.

F. C. Hallmark: There is a seal ring that is very efficient for use around old sleeve bearings for keeping in oil or grease. I cannot recall the trade names of these rings, but there are several on the market. One in particular is very efficient. It is more of a seal ring for the ends of plain type bearings.

P. Ruff: Mr. Young described that device this afternoon. It is a leather seal and spring fabricated. It is called a perfect seal.

N. C. Goin: If you flush out a bearing that is supposed to run one half or three quarters full, how do you get that extra half or quarter out of the bearing?

J. L. Young: A crane bearing is generally stationary at the time of lubrication. Should the housing be pumped full, it will start to clean itself through the vent plug as soon as the bearings start rotating, provided the seal is tight. If the seal is loose or badly worn, the grease or oil will naturally find its way out along the shaft through that opening, but we of course are assuming that we have a good seal in connection with the bearing housing. The bearing will then force all excess grease out through the vent plug and will then operate in its normal manner. The crane operator or lubrication man, after a few experiences like this, will be able to better judge and gauge the amount of grease to put in each time, and how often to add that amount of grease. If these bearings could be lubricated while running from a centrally controlled station, the operator could watch for the first sputter or spurt of grease from the vent plug and shut off his pressure at that time, but when the bearing is stationary there is more guess work connected with it.

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DISCUSSION

Precision Measurements of Mechanical Dimensions By The Use of Electricity

(Continued from page 36)

larities of the hot strip are carried through the first pass and are noticeable on the indicator of the gage applied at this point. However, as the strip passes through the several mill stands, these irregularities are gradually ironed out, and the instrument located after the last pass will give you an excellent record of the finished gauge.

S. B. Terry: I have noticed gradual reductions where you started in with hot strip that shows steps of .002 of an inch, plus or minus. On each successive pass that step is gradually reduced until after four or five passes the needle stands almost still and movement is very slow and it seems to be gradual. You don't get sudden jumps, but get a gradual tendency to build up or down. You may have hard spots in the strip that give you these variations.

W. A. Simpson: On roller bearings I do not believe that tolerance would be any closer than the speaker has mentioned. We do not attempt to gauge closer than .0001 of an inch.

W. Anderson: It might be interesting to hear some of the other applications that have been made.

S. B. Terry: We are building internal and external gages. We have laid out a number of automatic devices for selecting rolls in roller bearings running at 100 per min., in which case we check these rolls for roundness, taper, barrel shape and kick out the over-size. We select these rolls by .001 of an inch in four different groups, plus 1, 2, 3, and 4 and under-size. We have gages in the automotive plants for measuring wrist pins which have .0004 inch tolerance and these are selected in four groups. Both ends of the connecting rod are being measured for internal diameter. On these gages we use, in order to give long life, tungsten-carbide strips that run the length of this spindle. On the under side is an extension of our steel armature in which is mounted a diamond contact so we are getting a three-contact bearing. The rods are pushed over that spindle and given one turn to check the roundness. Previous to this method they were checking the large end of the rod on a progressive plug, having steps of .0001 of an inch. You can imagine what would happen to these steps of .0001" with a leverage of 10 inches forcing the rod on. They were scrapping a plug at the rate of one a day at a cost of $30 a piece and

"were up in the air." When they came to select pins by the previous method they were not accurate because instruments did not work close enough. It is a selective assembly proposition because to manufacture to .0001 of an inch the production cost is prohibitive but it is practical to select to ranges of .0001 of an inch. They were "diamond boring" the small end of the rod. Before the electric gages were installed their production line was in trouble and you know what it means and what it costs to hold up a steel mill to change rolls, so you can imagine what it means to hold up an automobile assembly line. The electric gages solved their problem. We are putting in at a plant a number of multiple gages whereby they are taking as many as five dimensions at once. Due to the fact that micro-ammeter has readings stretched out on a long scale the operator can read three or four instruments, because he has very definite lines within which his pointer must rest and if you stretch out a .0001 to ¾" you do not have any trouble to know where that pointer lands.

At General Electric, they put in the first gages in the refrigerator plant. In fact, they developed this for their own refrigerator. Later on it was manufactured for commercial work.

ITEMS OF INTEREST

PERSONNEL CHANGES

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Mr. W. E. Miller of the Johnstown Plant of the Bethlehem Steel Company has been made Superintendent of the Maintenance Department, which includes the Mechanical and Electrical Operating Departments of that company.

W. E. MILLER

Mr. Miller started to work at the Johnstown Plant in 1900 as an electrical repairman. In 1907 and until 1909 he was in charge of one of the earliest electrifications of iron ore mines in the Menominee Range at Vulcan, Michigan. In 1909, Mr. Miller was made Construction Foreman of the Electrical Department at the Cambria Works, which position he held until 1920, when he was made Assistant Superintendent of the Electrical Department. In 1925 Mr. Miller succeeded the late Mr. Proudfoot as Superintendent of the Electrical Department; Mr. Proudfoot having resigned to accept the position of General Manager of the Vanadium Alloy Corporation at Niagara Falls.

Mr. Miller is an Active Member of the Association of Iron and Steel Electrical Engineers. He has served on many of the National Committees of this Organization; also on the Board of Directors as Secretary, Treasurer and is now the First Vice President of this Society.

Mr. Miller has always taken an active interest in all of the technical affairs of this Organization and has presented many very able discussions on the problems which confront the Steel Industry.

The Association wishes to extend to Mr. Miller their sincerest congratulations on his new capacity. His host of friends throughout the Iron and Steel Industry will be pleased to learn of his advancement.

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J. E. Montgomery has been named vice president in charge of operations of the Otis Steel Co., Cleveland, succeeding R. H. Clark, who requested an indefinite leave of absence for the purpose of relaxation and an opportunity for travel. Mr. Montgomery, who has been with the Otis company several months as assistant to the president, was formerly assistant to the president and vice president in charge of operations of the Wheeling Steel Corporation, and has had 30 years' experience in the steel industry.

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E. W. Pargny, president, American Sheet & Tin Plate Company, Pittsburgh, has been granted a leave of absence until December 31, 1933. C. W. Bennett, vice president, assumes the duties of president, with the title of acting president, during this period. D. A. Barrett, assistant to the vice president, has been appointed vice president in charge of operations.

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Harry A. Schultz has been appointed to succeed the late Charles L. Close as manager of the bureau of safety, sanitation and welfare of the United States Steel Corporation, New York. John H. Osmers, of the chairman's office, will be assistant manager, succeeding Mr. Schultz.

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E. A. Livingstone has been appointed a sales representative of The Babcock & Wilcox Company and The Babcock & Wilcox Tube Company, with headquarters at 85 Liberty street, New York City.

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Frank H. Gale, manager of conventions and exhibits of the General Electric Company, has been retired at his request after 43 years of service with the company. L. W. Shugg has been appointed division manager of the publicity department to succeed Mr. Gale in charge of that work.